McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps

John B. McCraw
Phillip G. Arnold

Interplast
Healing Bodies, Changing Lives

Global-HELP
Publication

LATISSIMUS DORSI

ANATOMICAL CONSIDERATIONS

Surface Markings

The margins of the latissimus dorsi muscle extend from the tip of the scapula to the midline of the back posteriorly and to the iliac crest inferiorly. The anterior border of the muscle passes on an oblique line from the midpoint of the iliac crest to the axilla. This prominent border forms the posterior axillary fold with the teres major muscle.

Origin and Insertion

The muscle originates from a broad front, extending from the iliac crest and the surface of the external oblique muscle inferiorly to the thoracolumbar fascia and the spines of the lower six vertebrae posteriorly. In the midportion of the latissimus muscle there is a significant attachment to the surface of the serratus anterior muscle and the lower four ribs. Superiorly it is densely adherent to the surface of the teres major muscle. The latissimus muscle inserts into the lesser tubercle and the intertubercular groove of the humerus in front of the teres major muscle. Although there are numerous important functions of the latissimus dorsi muscle, the only one which is unduplicated by other muscles is best described by the terminal action of "pushing off" with a ski pole. Otherwise, it primarily acts as an adductor and medial rotator of the arm.

Adjacent Muscles

The latissimus dorsi muscle covers a portion of the paraspinous muscles and the majority of the serratus anterior muscle. Inferiorly it is fused with the external oblique muscle. Superiorly it is firmly attached to the inferior border of the teres major muscle.

Vascular Pattern

The latissimus dorsi muscle has a dual blood supply from the subscapular artery and the posterior paraspinous perforators. Both circulatory systems are diffusely interconnected in the classic fashion of a broad, flat muscle. The thoracodorsal branch of the subscapular artery, measuring approximately 2.5 millimeters in diameter, is the dominant blood supply. When this vessel has been sacrificed, the muscle can still be carried on the highest branch of the circumflex scapular artery. Though somewhat smaller, this vessel usually provides a reliable blood supply. Either of these proximal vessels can supply the entire muscle with the exception of the most distal aspects of the latissimus muscle. The distal muscle is predominantly supplied by the posterior perforating vessels, which are seen as two rows of segmental vessels respectively lying five to ten centimeters from the midline of the back. There are usually four to five vessels in each segmental row, and their individual size approximates 1.5 millimeters in diameter.

Motor Nerve

Thoracodorsal nerve.

Sensory Nerve

Dorsal cutaneous rami (D six through twelve).

USES

In addition to its frequent use for breast reconstructions, the latissimus dorsi flap is applicable to many anterior and posterior chest wall defects as well as major coverage problems of the axilla, shoulder, and neck. It is used less often than the pectoralis major myocutaneous flap for intra-oral defects, but the latissimus flap will more easily cover massive defects of the temporal area. The latissimus muscle flap will always reach the upper sternum, but it cannot be relied upon to cover the lower one-third of the sternum. The latissimus muscle serves as an excellent functional replacement for the biceps muscle or, less commonly, the triceps muscle. It also can be used to correct surface coverage problems of the upper arm extending to the elbow. The proximally based latissimus muscle is the obvious flap of choice for major upper back and scapular defects.

The latissimus muscle has occasionally been used as a "reversed" flap for defects of the lower thoracic and lumbar areas, but the muscle is almost always employed as a bilateral myocutaneous advancement flap for these defects. This bilateral latissimus dorsi advancement flap has revolutionized the soft tissue coverage in spina bifida patients because of its simplicity and reliability. In these cases the release of the anterior fascial attachments of the latissimus muscle to the chest wall and chest skin facilitates an adequate posterior advancement without the need for a counterincision or a skin graft in the flank. This uncomplicated maneuver significantly decreases the morbidity, blood loss, and operative time in these critical newborn neurosurgical closures. Unlike the "reversed" latissimus flap, bilateral advancement flaps do not defunctionalize the latissimus muscle in paraplegic spina bifida patients.

REGIONAL FLAP COMPARISONS

The pectoralis and latissimus muscles have comparable capabilities for their respective anterior and posterior chest wall applications. The latissimus myocutaneous flap is preferred for posterior back, posterior neck, and temporal defects which are not reached by the pectoralis major flap. Conversely, the pectoralis flap is more accessible for defects of the sternum, anterior chest, neck, and the intra-oral area. Both flaps can be used for replacement of the upper arm skin and for elbow flexion, but the latissimus dorsi muscle is usually chosen because of its muscular strength, its size, and its less significant donor site deformity. The latissimus muscle flap is useful for defects of the posterior neck, but the occiput can be covered more easily by either the horizontal or the vertical trapezius myocutaneous flaps. For defects of the posterior spine, bilateral advancement latissimus dorsi myocutaneous flaps provide unique coverage for spina bifida defects or complicated laminectomy wounds. Although the latissimus muscle can be used as a "reversed" flap, bilateral latissimus dorsi myocutaneous advancement flaps are simpler to elevate and are much more reliable.

For purposes of breast reconstruction the latissimus dorsi flap is best compared to the transverse rectus abdominis myocutaneous (TRAM) flap. The TRAM (Hartrampf) flap is always preferred for an extensive radical mastectomy defect or for reconstructing a very large breast when necessary for symmetry. Because of its inherent softness and superb contour restoration capabilities, the TRAM flap has supplanted the use of the latissimus flap in most cases of breast reconstruction. The latissimus flap is still commonly used for the modified or simple mastectomy defect, but our enthusiasm has been tempered recently because we have identified an extremely high incidence of deforming capsular contractures. While the latissimus breast reconstruction has the advantages of improved implant coverage and a more natural "tear-drop" shape when compared to a subpectoral reconstruction, it also has the same implant-related imperfections found in the simpler subpectoral reconstruction. Elimination of implants in breast reconstruction has emerged as a more critical determinant of success than any other factor. We have abandoned the notion that simply giving the implants better muscular coverage could solve the "implant dilemma." For this reason, the TRAM procedure virtually always gives a better result than the latissimus procedure especially for patients with larger deformities. This change in attitude toward the latissimus reconstruction is remarkable when one considers that until 1981 the latissimus breast reconstruction was the unparalled standard method.

DISADVANTAGES

If all of the other muscles of the shoulder girdle are intact, the loss of the latissimus dorsi muscular function is rarely noticeable in normal activities, including tennis and golf. It has even been used in athletes who later returned to such activities as rope climbing, push-ups, and special military forces activities. Occasionally, the use of this muscle will result in some winging of the scapula. It can also compromise the motion of the posterior "push off," where the hand is directed behind the back. Because this is an important function in snow skiing, it must be considered in certain patients. For this reason the latissimus dorsi flap is not always championed by plastic surgeons in the ski areas of Europe.

The primary disadvantages are related to donor site complications. Unfortunately donor site pain and seroma formation are the rule rather than the exception. If the width of the skin removal exceeds five centimeters, one can expect a widened scar. When it is necessary to skin graft the donor site, poor graft "take" in this mobile area and an unsightly contour depression should be anticipated. In the event that the muscle is denervated, the muscle will still "carry" skin, but it does not contribute any appreciable bulk to the recipient site. No flap losses have been encountered when the thoracodorsal vessels have been intact in nonirradiated tissue. Minimal flap loss has occurred when the proximal flap was supplied by only the circumflex scapular vessels. If the latissimus muscle has been totally transected by a prior posterolateral thoracotomy, the latissimus muscle absolutely will not survive elevation in the area distal to the muscular scar.

ADVANTAGES

The robust viability of this magnanimous muscle flap constitutes its major commending feature even when it is only vascularized by the circumflex scapular vessels. It is certainly one of the most versatile flaps for reconstructive problems of the chest wall and the upper arm. The muscle flap alone will also supply unique coverage for massive defects of the temporal area, the neck, and the shoulder. Overall, the usefulness of this remarkable flap far overshadows its recognized disadvantages.

COMPLICATIONS, PITFALLS, AND DONOR SITE

Major complications have almost always been related to the extremely rare flap loss which has been caused by the absence of the thoracodorsal vessels or by massive amounts of irradiation to the axilla. If the donor vessels are appropriately mobilized, the flap does not appear to

be subject to vascular "spasm." Neither is cold a recognized threat to the flap.

Generally, the pitfalls of flap dissection are related to minor technicalities. While the dissection is straightforward, one must be sure to detach the upper border of the muscle from the teres major muscle so this attachment does not leave a "lump" in the axilla in the process of anterior transposition. It is also easy to elevate the serratus anterior muscle accidentally in the posterior flap dissection. The serratus anterior muscle should be carefully identified, and if it is raised with the latissimus muscle, it should be resutured to its site of origin. Following a radical mastectomy, the anterior border of the latissimus muscle may be so densely scarred that it is fused with the serratus anterior muscle. It is imperative to identify the latissimus dorsi muscle precisely; otherwise one can injure the thoracodorsal vessels which lie close to the anterior border of the muscle. In the case of a scarred muscle, the safest approach is to identify the latissimus muscle posteriorly and superiorly. This can easily be done by entering the submuscular plane at the thoracolumbar fascia, separating the latissimus and teres major muscles, and then finally identifying the vascular leash and the anterior border of the latissimus muscle in the axilla.

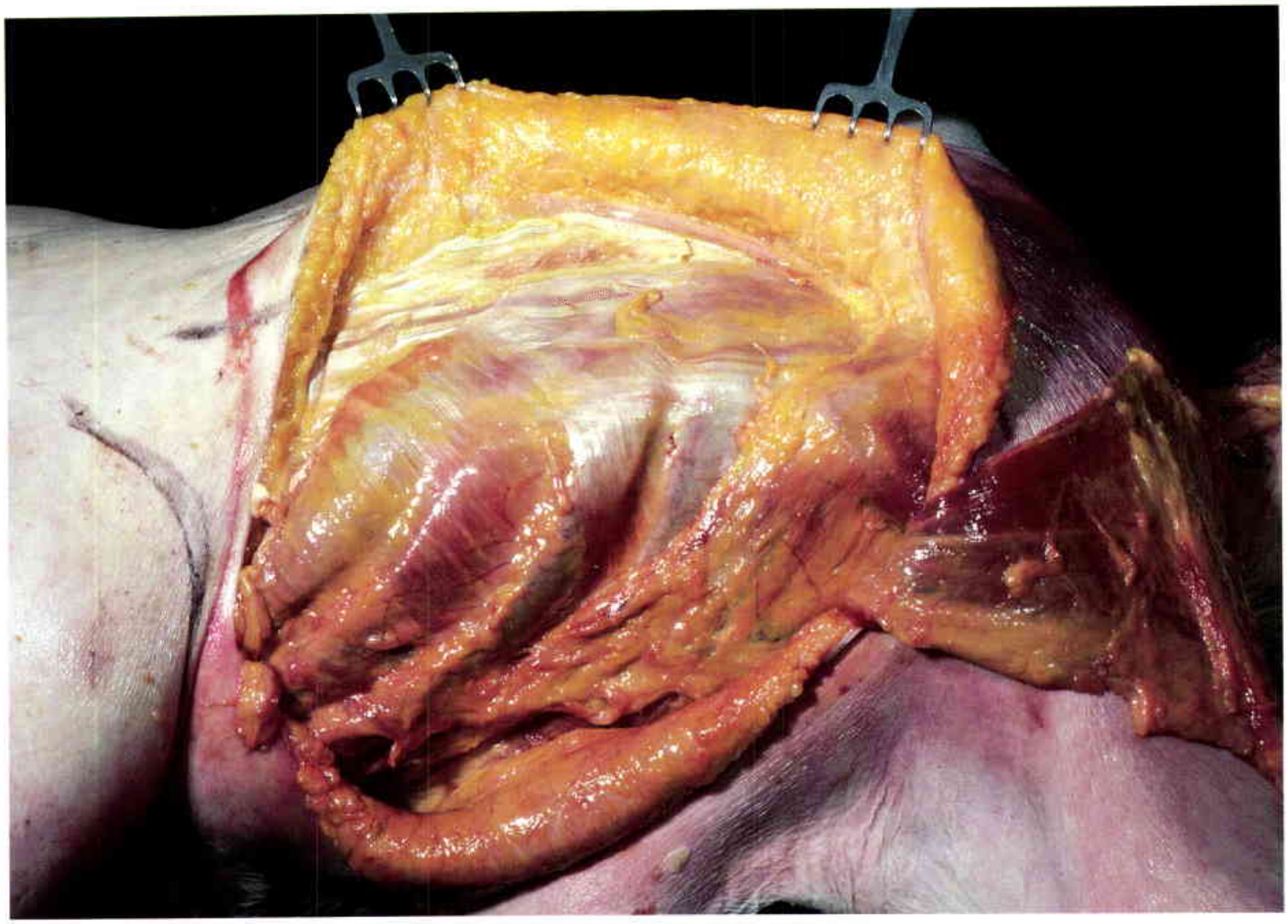
One should take care to protect the long thoracic nerve during the dissection even though it has not been injured in our cases. It is important to maintain a relaxed position of the arm during the flap dissection to prevent a stretch of the brachial plexus. Abduction of the neck and external rotation of the shoulder accentuate this stretch because this position produces the maximal tension on the brachial plexus. A few temporary ulnar nerve palsies have occurred, which suggest that precautionary measures are warranted. For this reason the arm should be draped "free" and observed directly.

The donor site has contributed the biggest disadvantage of this flap because of the high incidence of seroma formation which occurs even with adequate suction drainage. These seromas are occasionally difficult to eradicate and can result in the formation of a bursa. If this happens, it is usually possible to collapse the cavity with a Penrose drain. After four to six weeks this becomes an intractable problem, and it may be necessary to abrade or excise the two surfaces of the "bursa" to obtain healing.

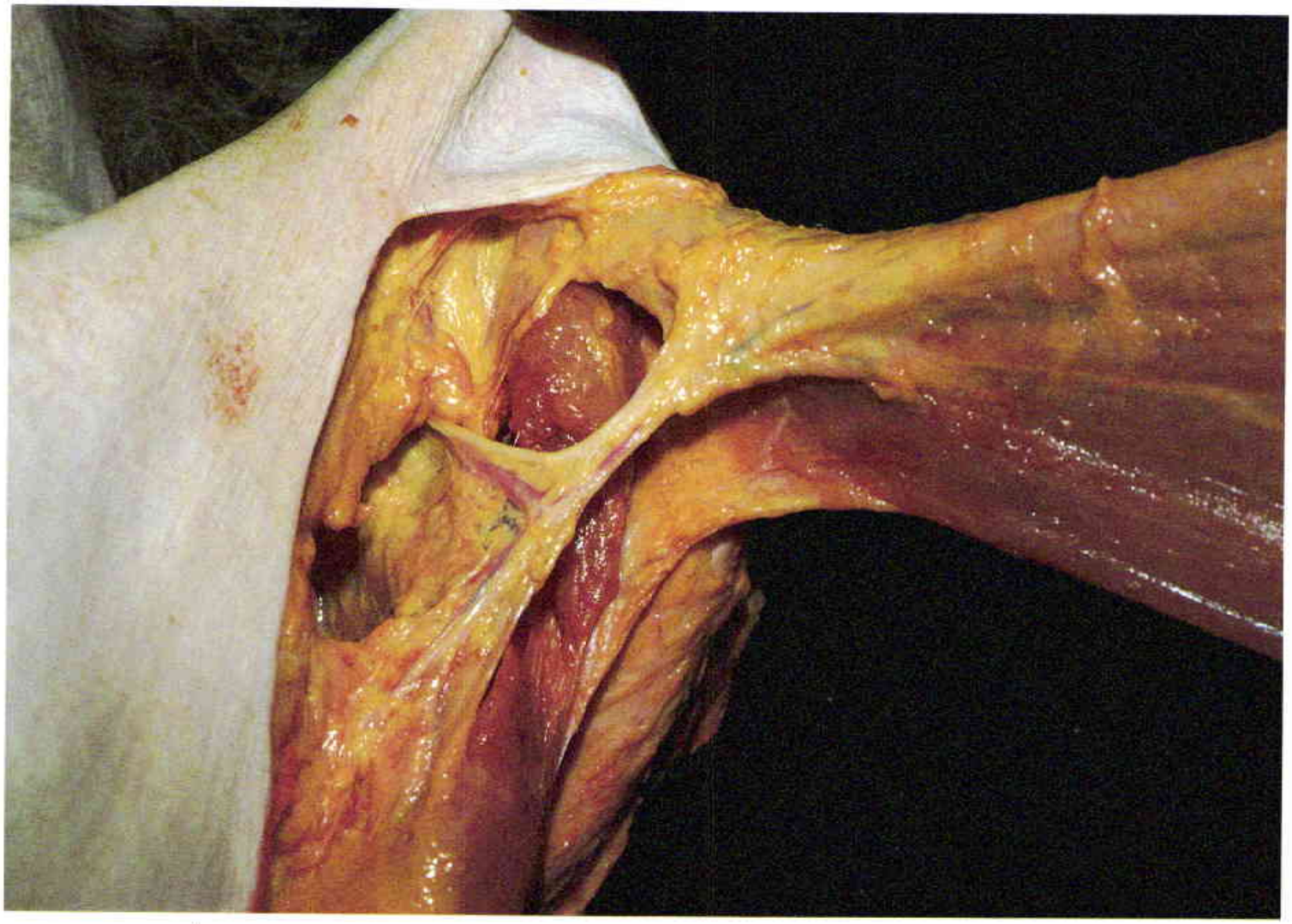
The donor site itself does not create any significant surface depression nor any excessive prominence of the ribs, but if more than five centimeters of skin is carried with the muscle, a widened scar can be expected. If a skin graft is required for the donor site, the resulting contour deformity can be remarkably unattractive, particularly in the obese patient.

1
Transversely oriented skin "island" on the lower portion of the latissimus muscle in a fresh cadaver. The scapula and iliac crest are outlined in black.

2
Latissimus muscle exposed through a vertical incision. The thoracolumbar fascia is visible superiorly.

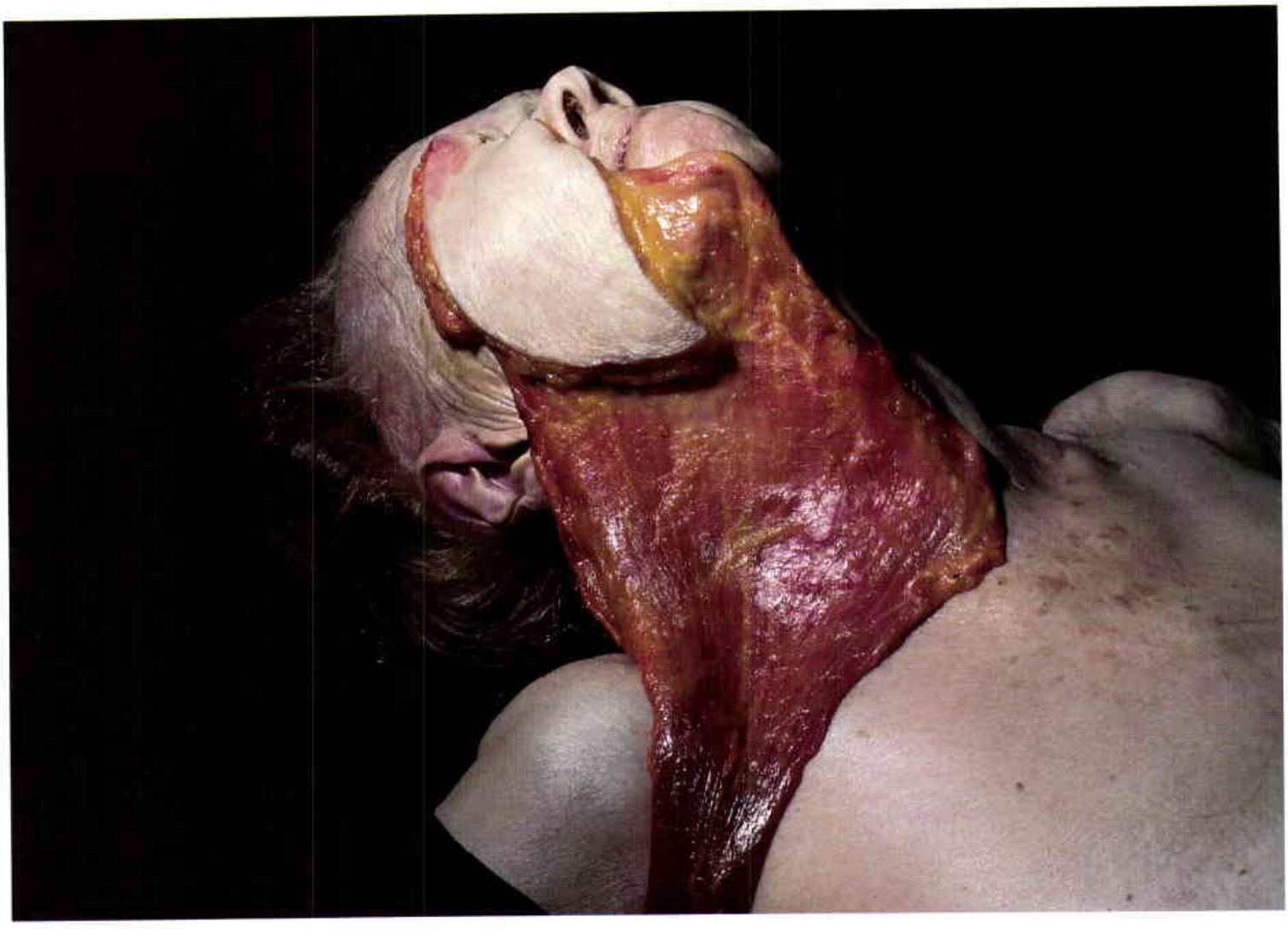


3
Transposed latissimus muscle. The serratus anterior and external oblique muscles are seen on the chest wall.

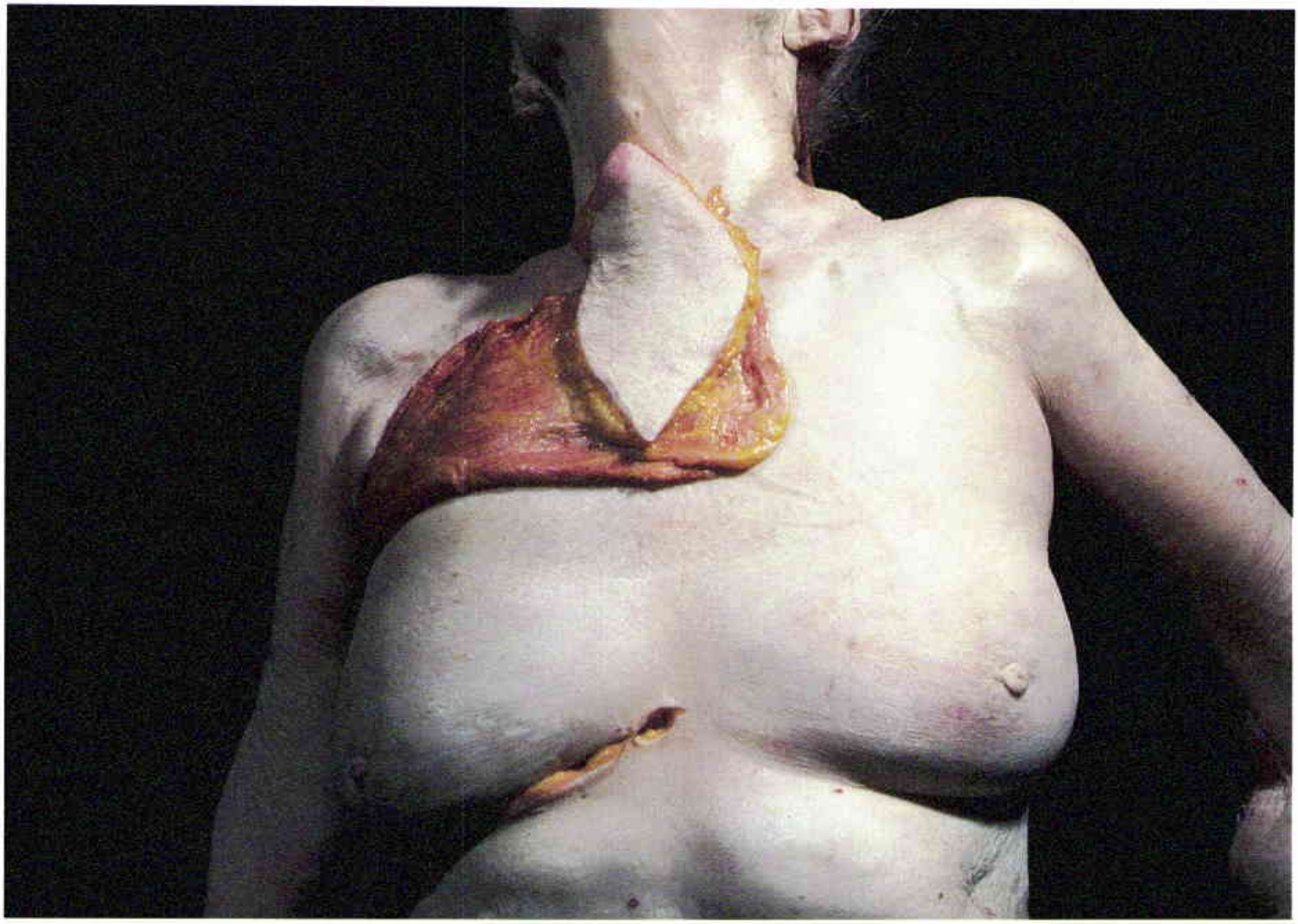


4

This left axillary dissection demonstrates the subscapular artery with its major branches which pass superiorly to the latissimus dorsi muscle and inferiorly to the serratus anterior muscle. The thoracodorsal artery is seen crossing the surface of the teres major muscle and entering the undersurface of the latissimus muscle approximately two centimeters from its anterior border.

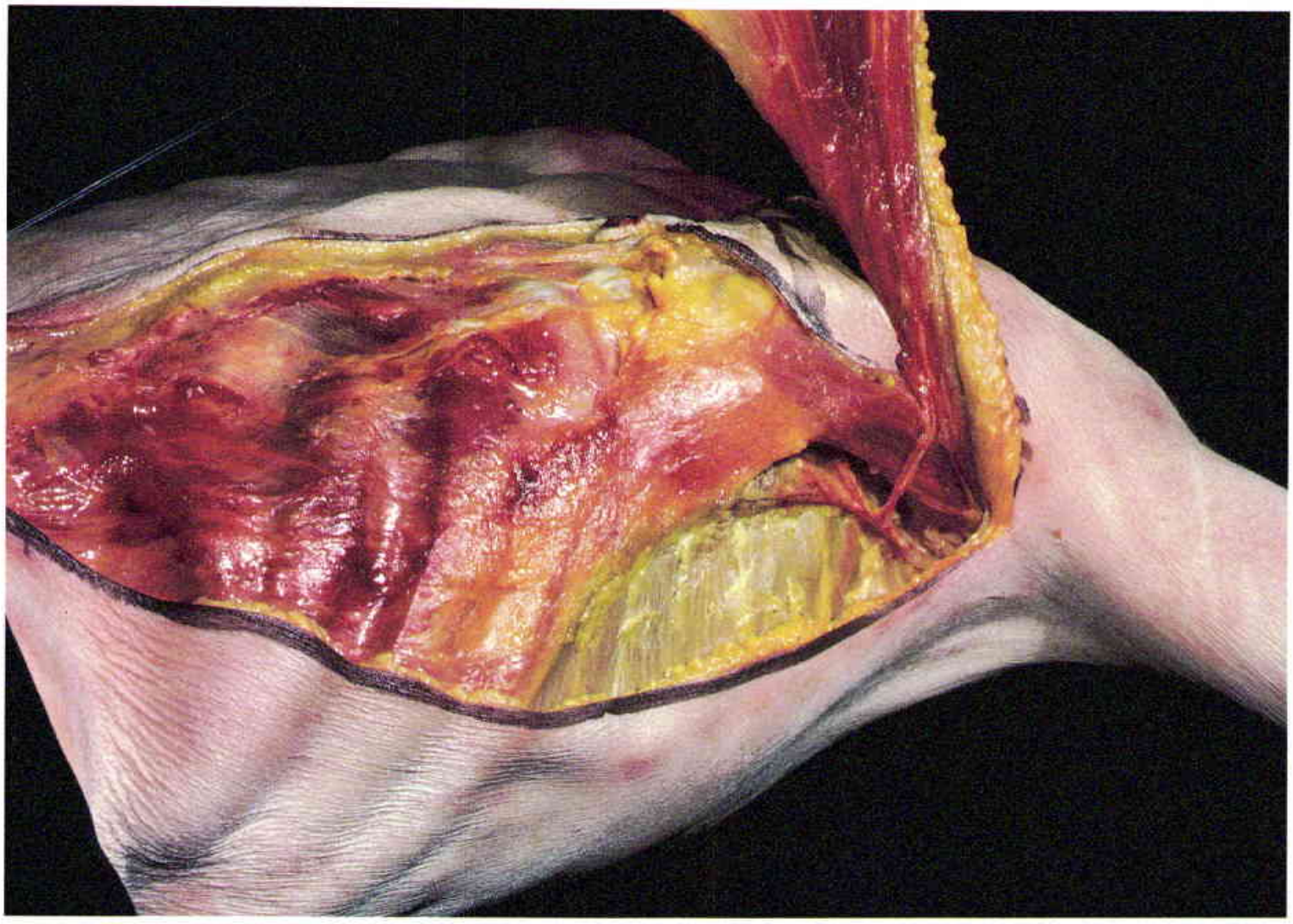


5
Upward rotation of the low transverse skin "island" to the face. The posterior portion of the latissimus muscle covers the lower neck.

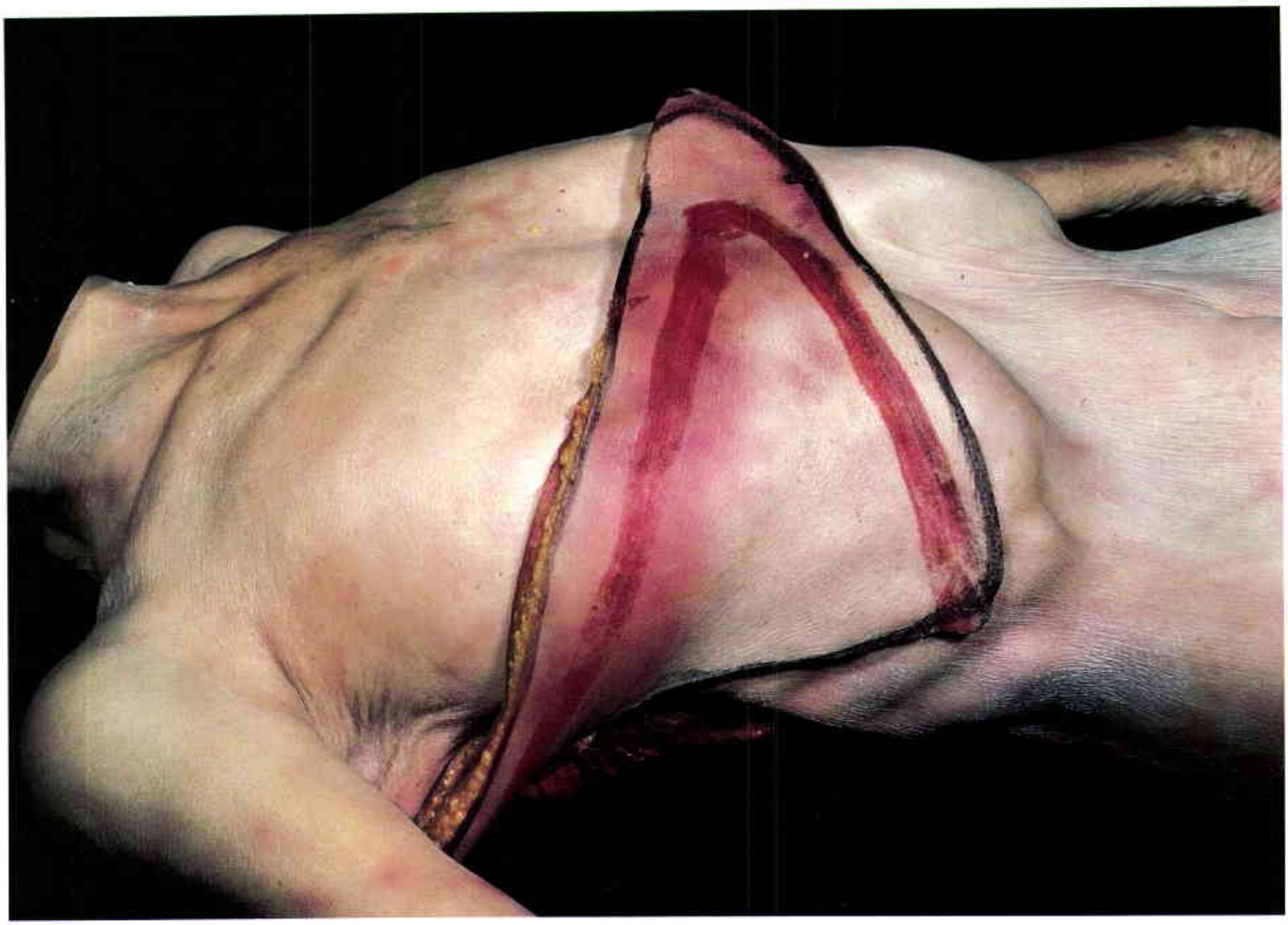


6
Coverage of the upper sternum by the low, transverse skin "island."

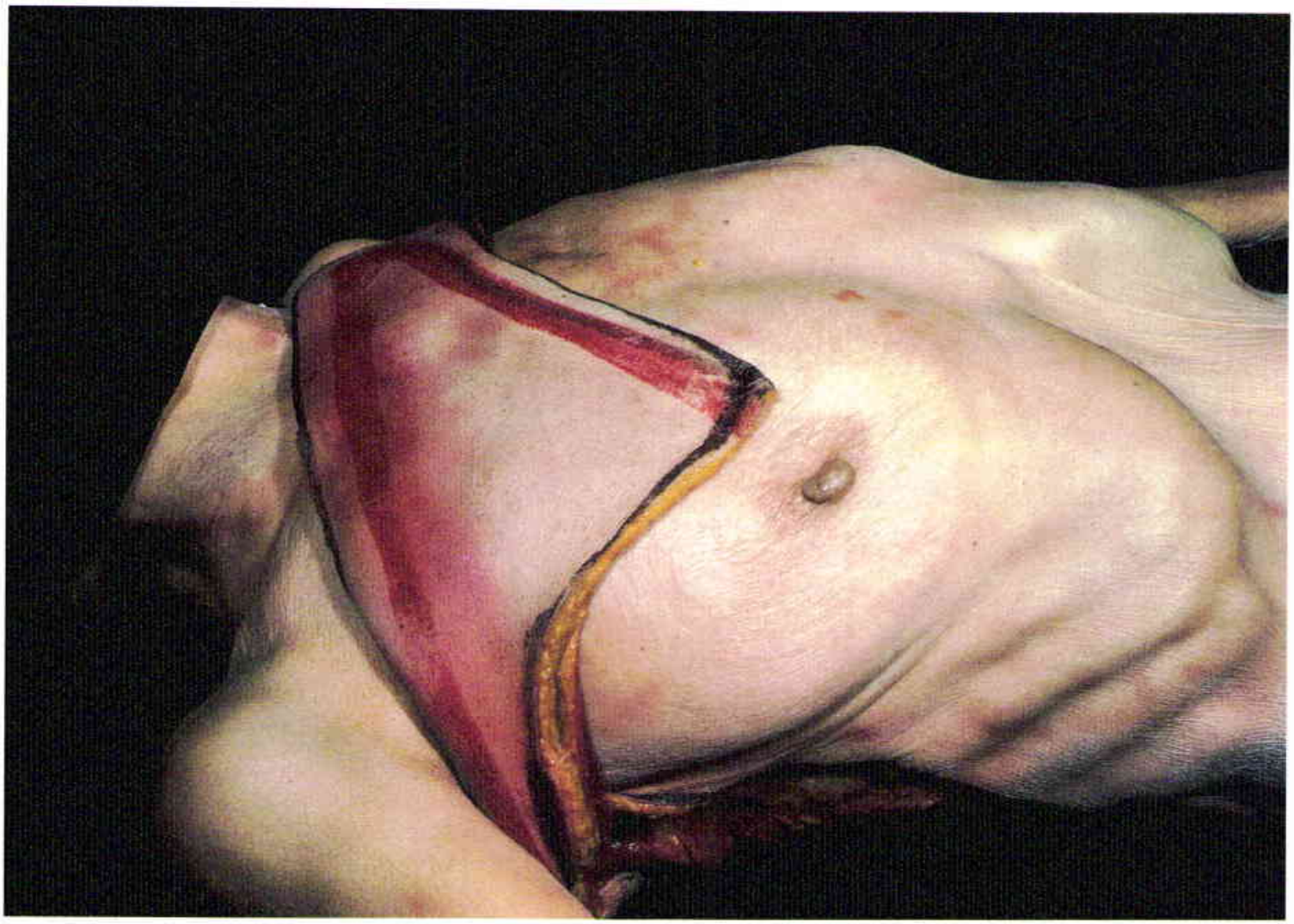
7
Total elevation of the latissimus muscle and its overlying skin in a fresh cadaver.



8
Elevation of the latissimus flap exposes the thoracodorsal artery and the serratus anterior branch.



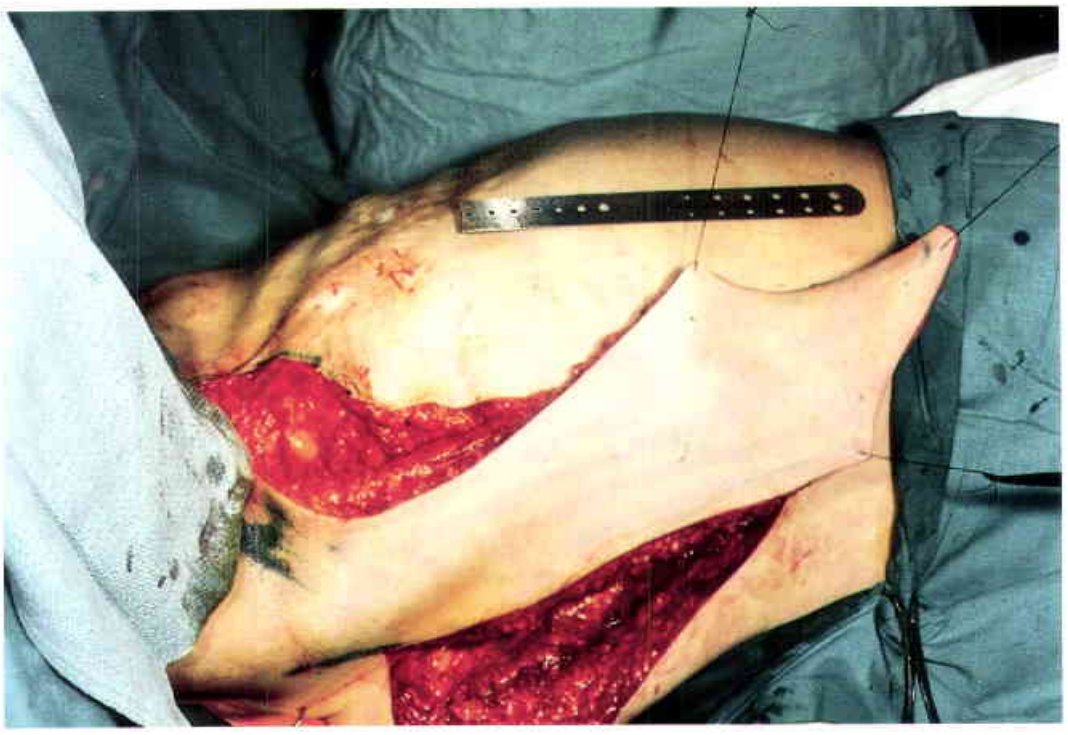
9
Transposition of the entire latissimus muscle and all of its overlying skin to the lower chest wall and sternum.



10
Transposition of the complete latissimus myocutaneous unit to the upper chest wall.

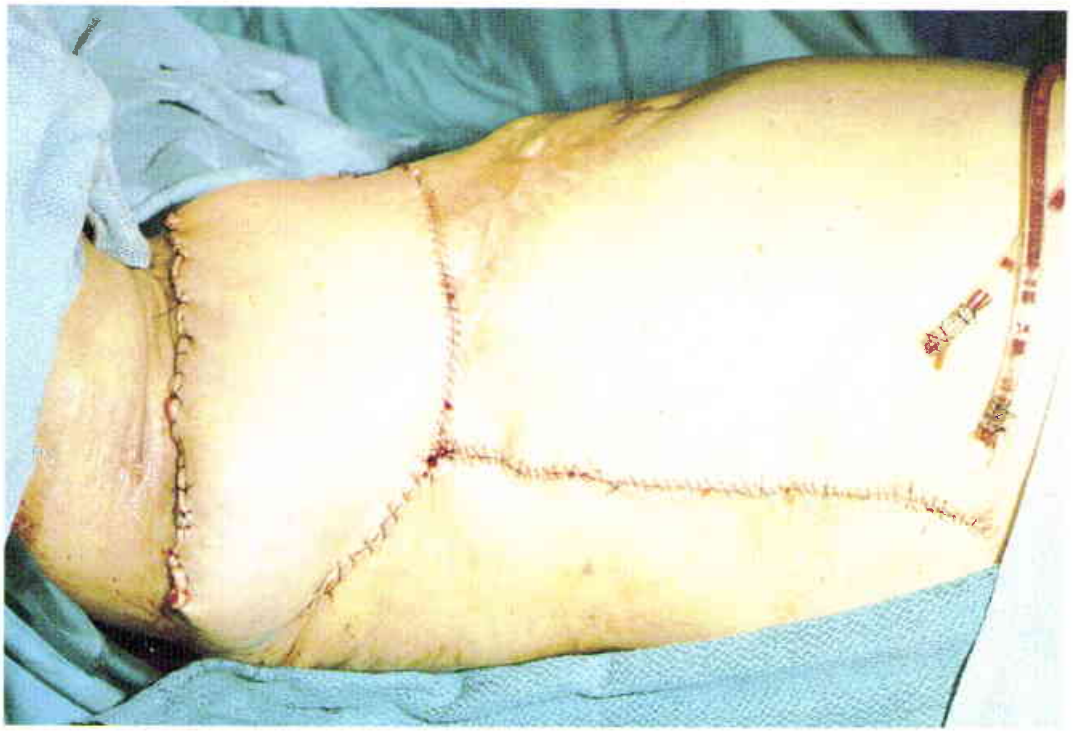
11

Fifty-nine-year-old patient with an exposed cardiac pacemaker wire adjacent to the clavicle. The patient had previously had a radical mastectomy and the surrounding skin had been heavily irradiated. The pacemaker wire was not infected from a technical standpoint. It was important to salvage this pacemaker since all previous implantations had failed. This 1974 case is included for historical interest since it is apparently the first latissimus dorsi myocutaneous flap done in the United States. (Case of J.B. McCraw)



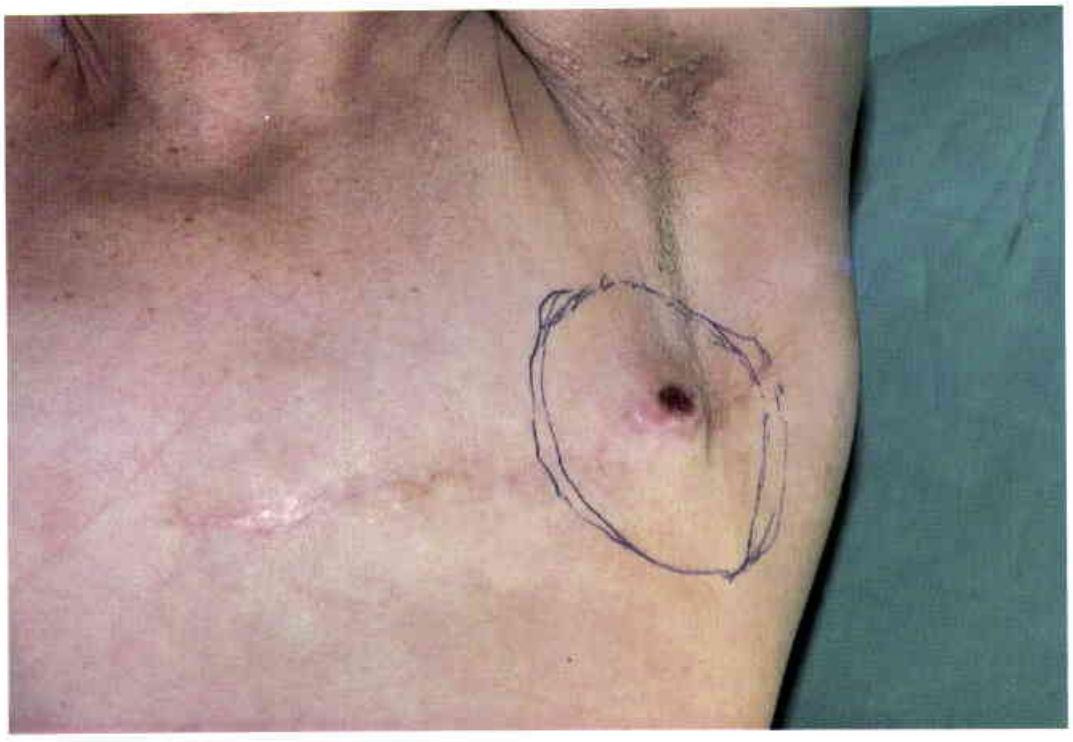
12

As a precautionary measure, the thoracodorsal vessels were identified prior to flap elevation. The anterior half of the latissimus muscle and its overlying skin were elevated without a "delay." It is interesting to note that this is precisely the same operation performed by Professor Tansini seventy-five years earlier.



13
The latissimus muscle was used to surround the pacemaker wire following a wide debridement. An "island" skin flap was not created since it was not known at the time whether this would harm the viability of the distal flap skin.

14
Healed latissimus myocutaneous flap with salvage of the pacemaker.



15
Sixty-year-old patient with what was thought to be "persistent" tumor in a three-month-old mastectomy scar. (Case of J.B. McCraw and J.W. Baker)

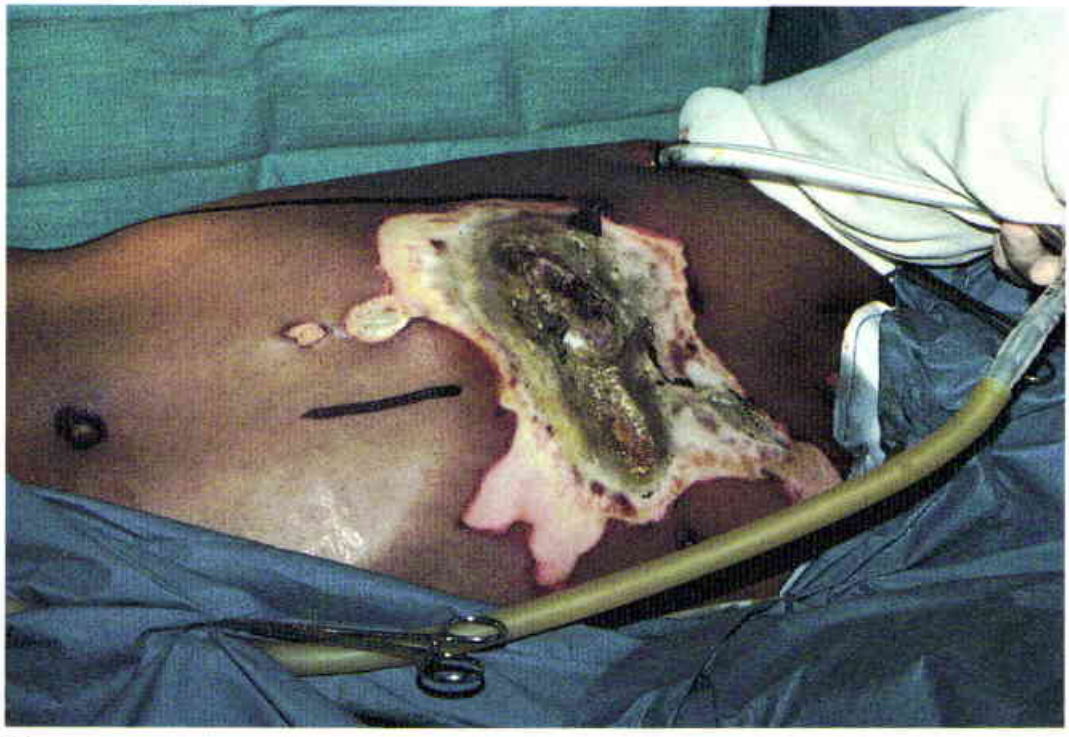
16
The tumor excision included the full thickness of the chest wall. Even though the metastatic survey was unremarkable, a small, recurrent tumor nodule was found on the surface of the lung.

17
Outline of the latissimus dorsi musculocutaneous flap which includes the anterior half of the muscle.

18
The latissimus dorsi muscle was first approximated to the chest wall defect. The skin was then forcibly contoured to accommodate the muscle closure.

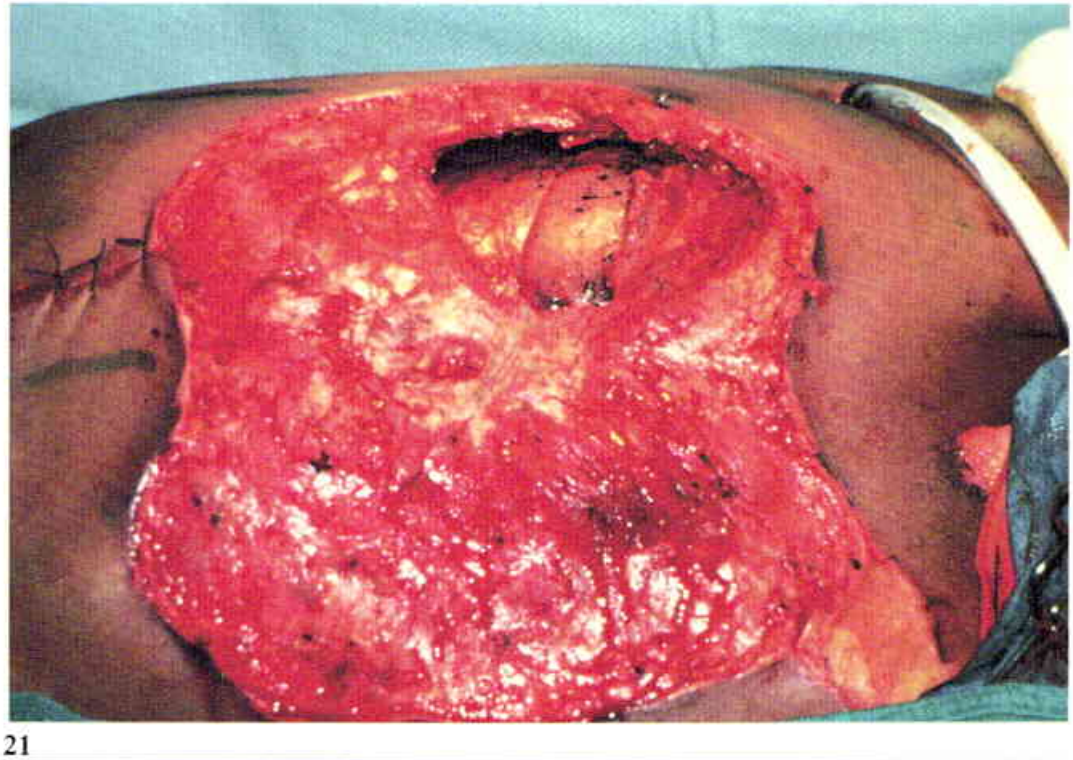
19

Healed myocutaneous flap at one year. This case is of interest because it is the first reported latissimus dorsi myocutaneous flap used for a full-thickness chest wall defect. The ability of the flap to withstand the convoluted closure confirmed the impression that the myocutaneous flap skin is directly supplied by the underlying muscle rather than by longitudinal cutaneous vessels. This simple principle had not been established at that time.



20

Thirty-six-year-old male who sustained a high voltage electrical injury with full-thickness destruction of the chest wall. A chest tube was placed in the axilla to control the sucking chest wound, and the patient was immediately brought to the operating room. (Case of J.B. McCraw and J.W. Baker)



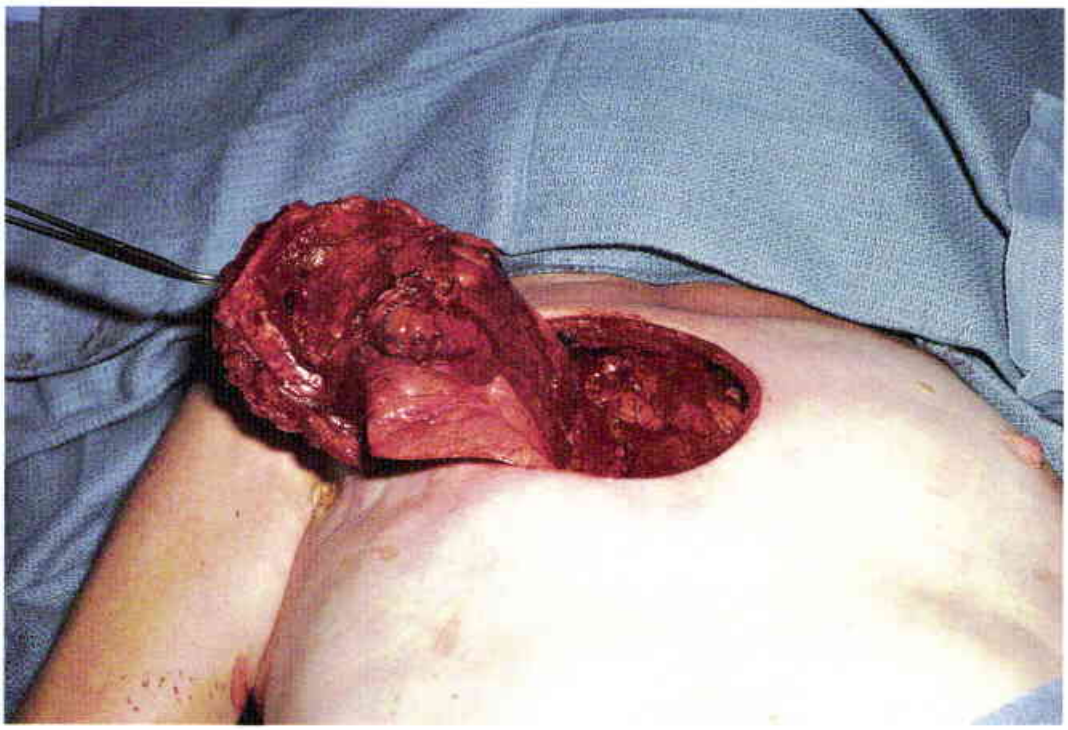
21

Four ribs were excised from the right anterior chest wall. The lower half of the sternum was later removed. The middle lobe of the right lung was also injured by the high voltage injury and a partial lobectomy was necessary.

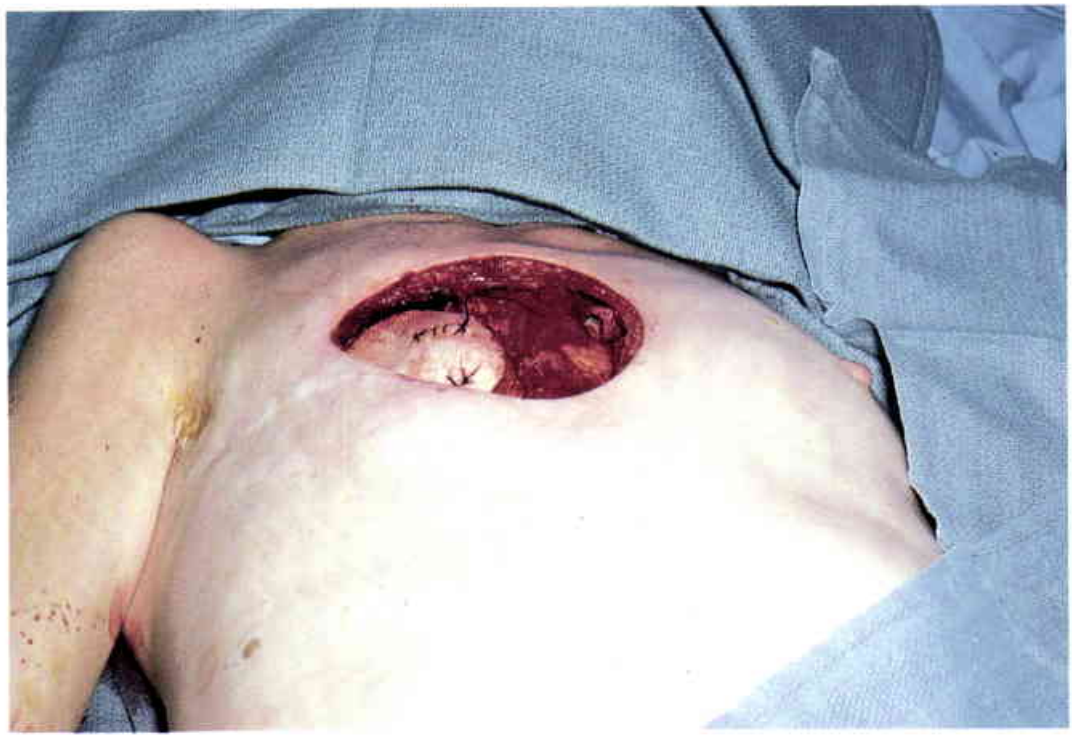
22
The entire latissimus muscle was elevated with a massive amount of skin which extended from the level of the nipple to the iliac crest and to the midline of the back posteriorly.

23
Healed flap and donor site at six weeks. The patient eventually returned to his previous employment. The coverage of potentially lethal chest wounds is now a routine matter. In 1976 we were unsure whether such a large myocutaneous flap would survive.

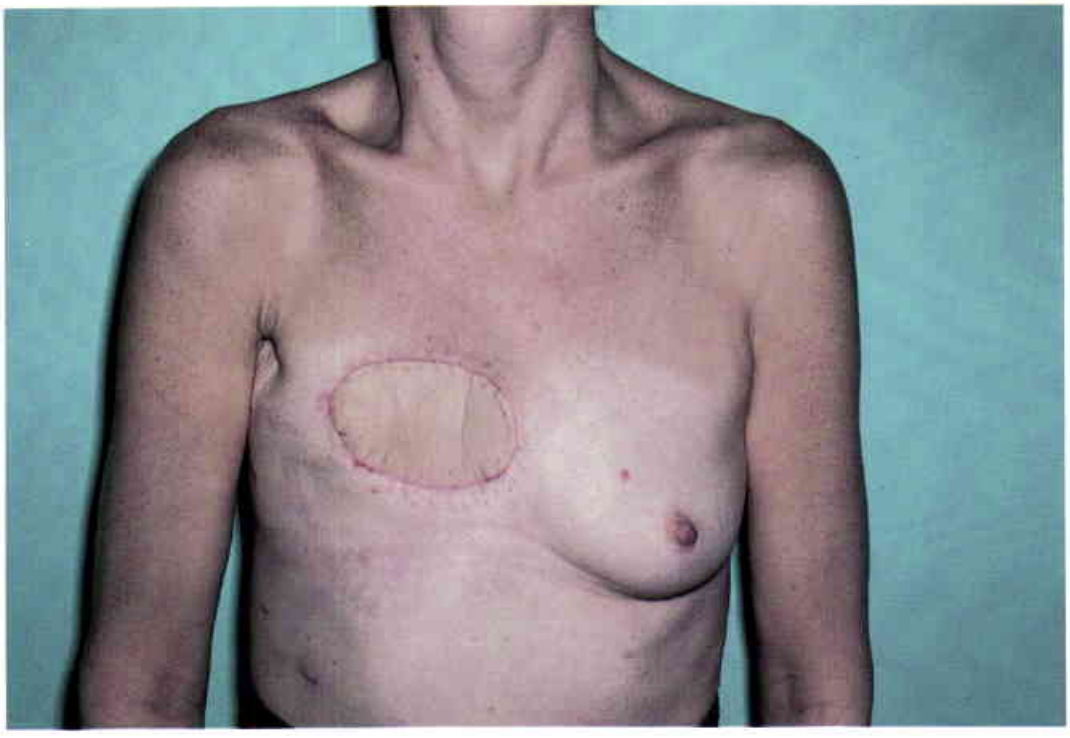
24
Forty-five-year-old woman following a modified radical mastectomy with a chest wall recurrence of breast cancer. (Case of P.G. Arnold)



25
The full-thickness chest wall resection includes a portion of the underlying lung which is attached to the tumor.



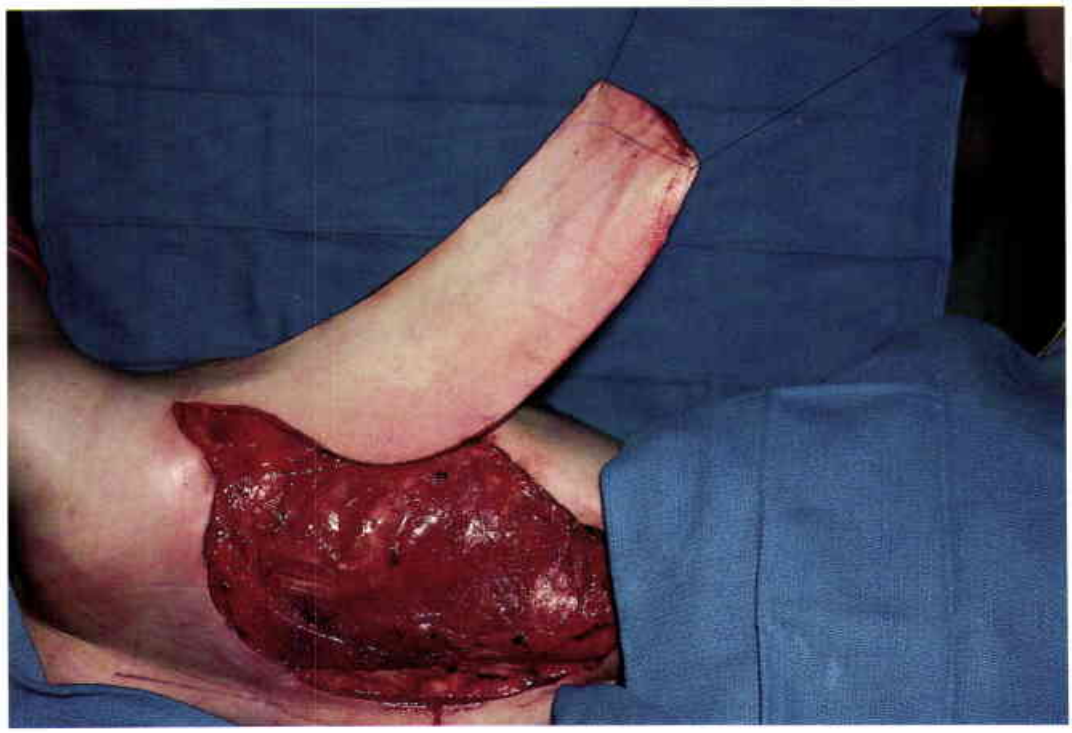
26
Chest wall defect. Gortex® was used to replace the thoracic skeleton.



27
A latissimus dorsi myocutaneous flap was used to correct the soft tissue defect.

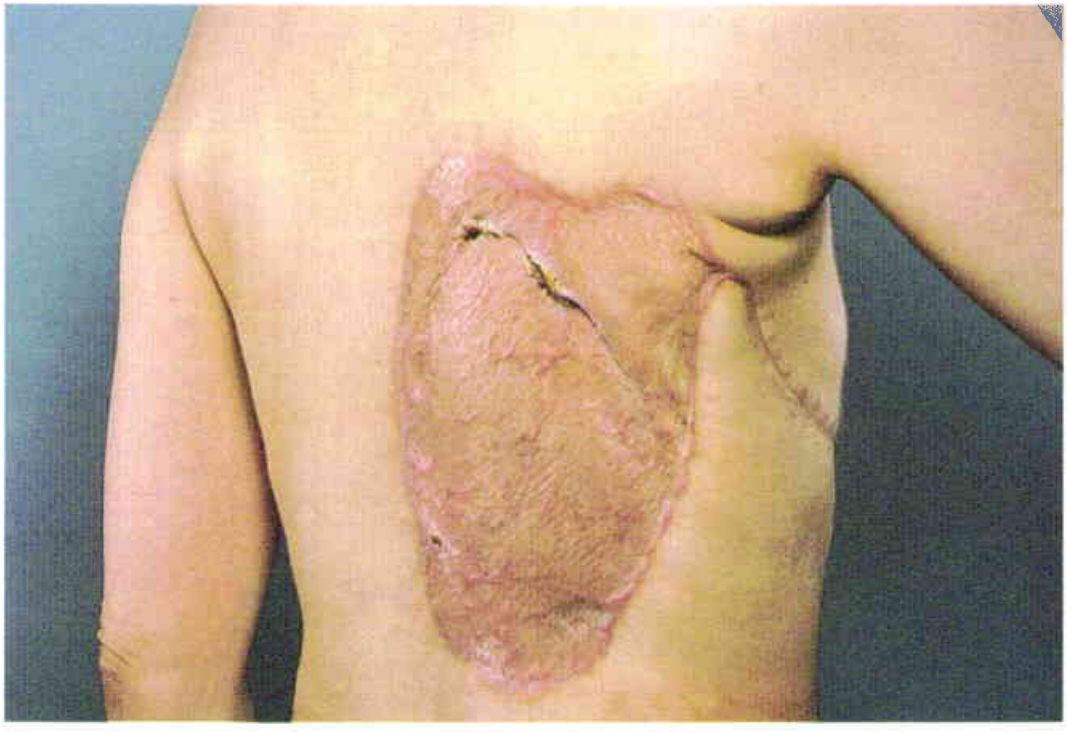
28, 29

Forty-seven-year-old female who underwent a lumpectomy and irradiation for a carcinoma of the breast two years earlier. The recurrent tumor diffusely infiltrates the right breast which was destroyed by the conservative treatment. (Case of P.G. Arnold)

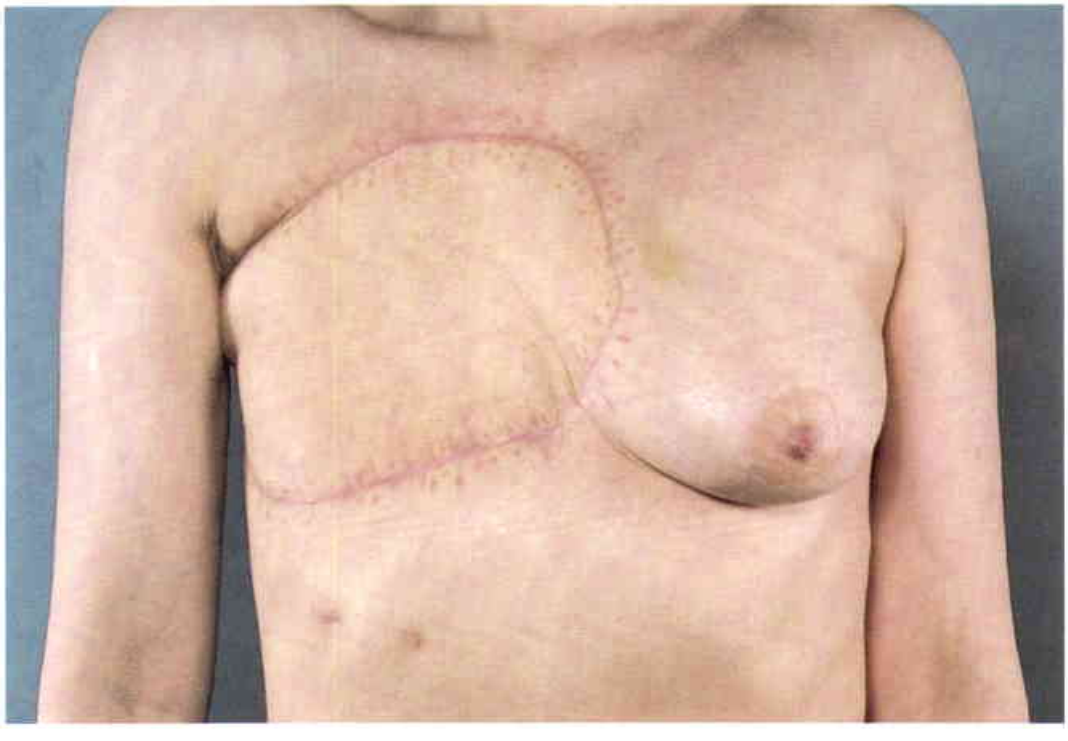


30, 31
The full-thickness resection included the entire breast and a portion of the chest wall. A large latissimus dorsi flap is elevated.

32
The thoracic skeletal defect was reconstructed with a Gortex® patch. The elevated latissimus dorsi flap is seen above the patch.



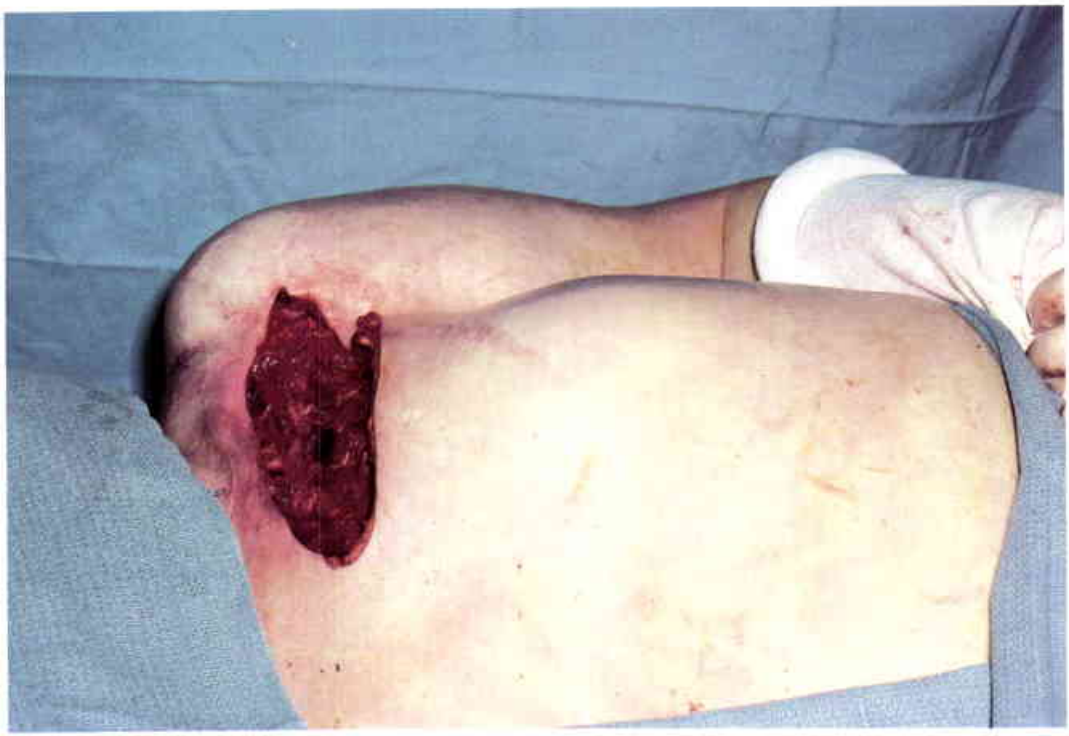
33
Skin-grafted donor site three months postoperatively. Note the problem of skin grafting the scapula.



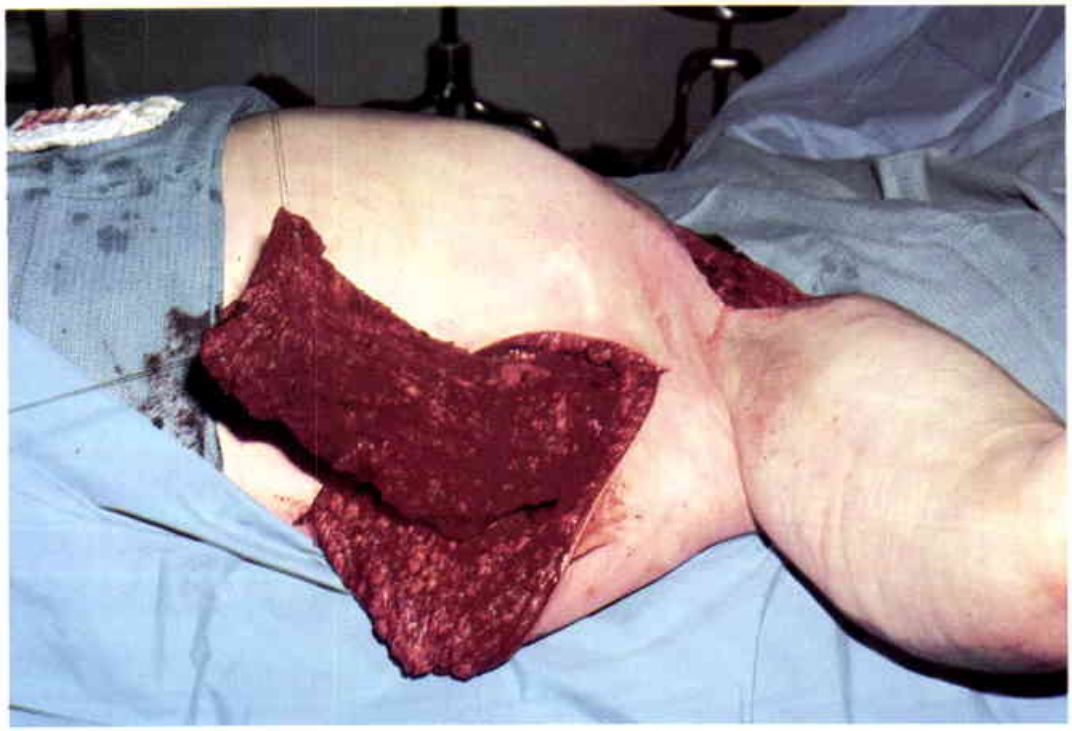
34, 35
Appearance of the anterior chest at three months.

36
Fifty-nine-year-old woman who had previously undergone a left radical mastectomy with extensive irradiation. The area over the left subclavian vessels had been ulcerated for three months. (Case of P.G. Arnold)

37
Close-up view of the subclavicular irradiation ulcer with an impending exposure of the subclavian vessels.



38
The full length of the subclavian vessels was exposed in the process of excising the irradiation ulcer. The wound debridement included the removal of the left clavicle and all of the damaged soft tissue surrounding the subclavian vessels.

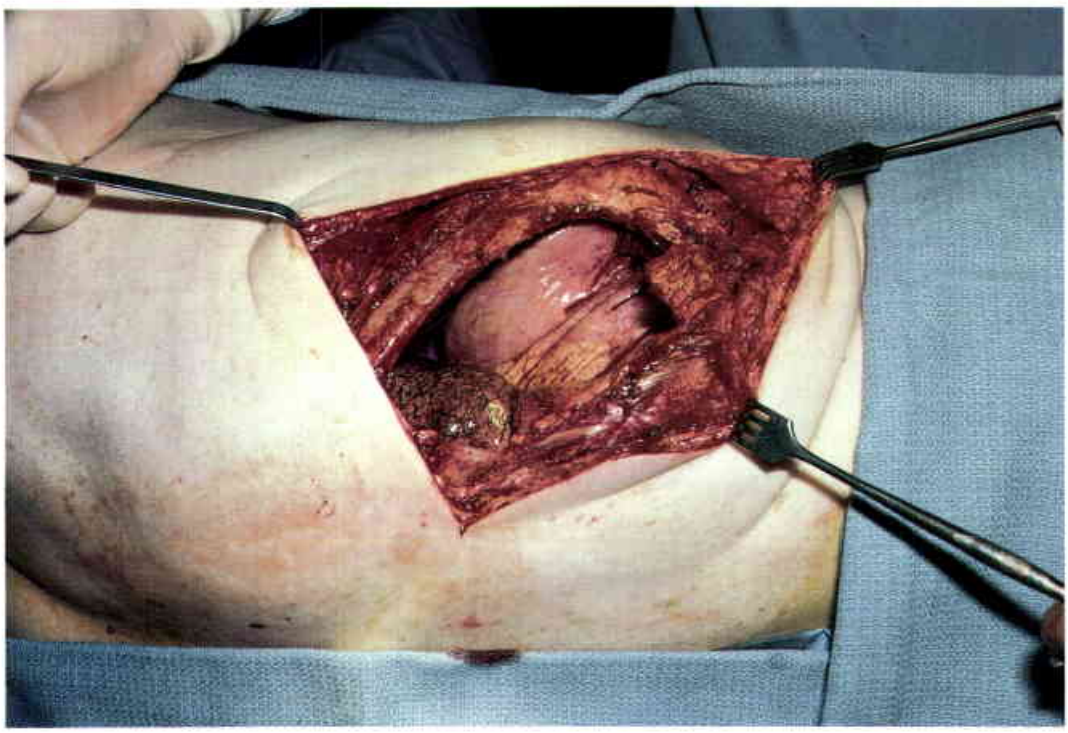


39
Elevated latissimus dorsi muscle flap.

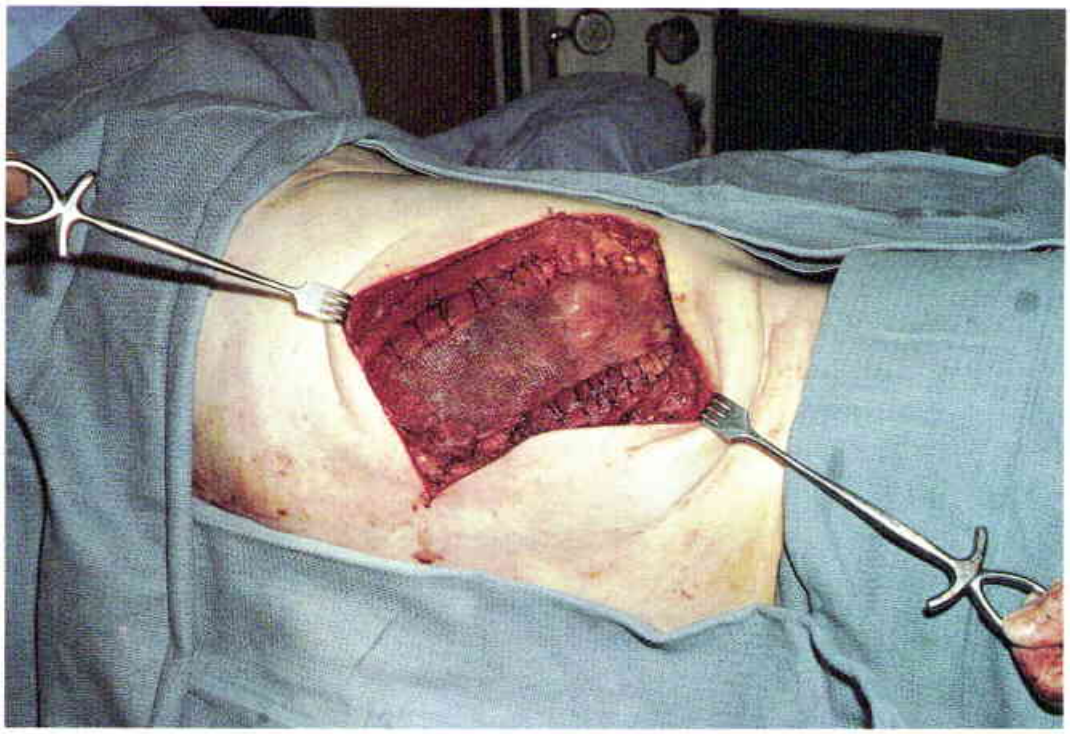
40
The latissimus muscle was transposed over the subclavian vessels and prepared for a delayed skin graft.

41
Postoperative result at seven months. The wound has remained soundly healed.

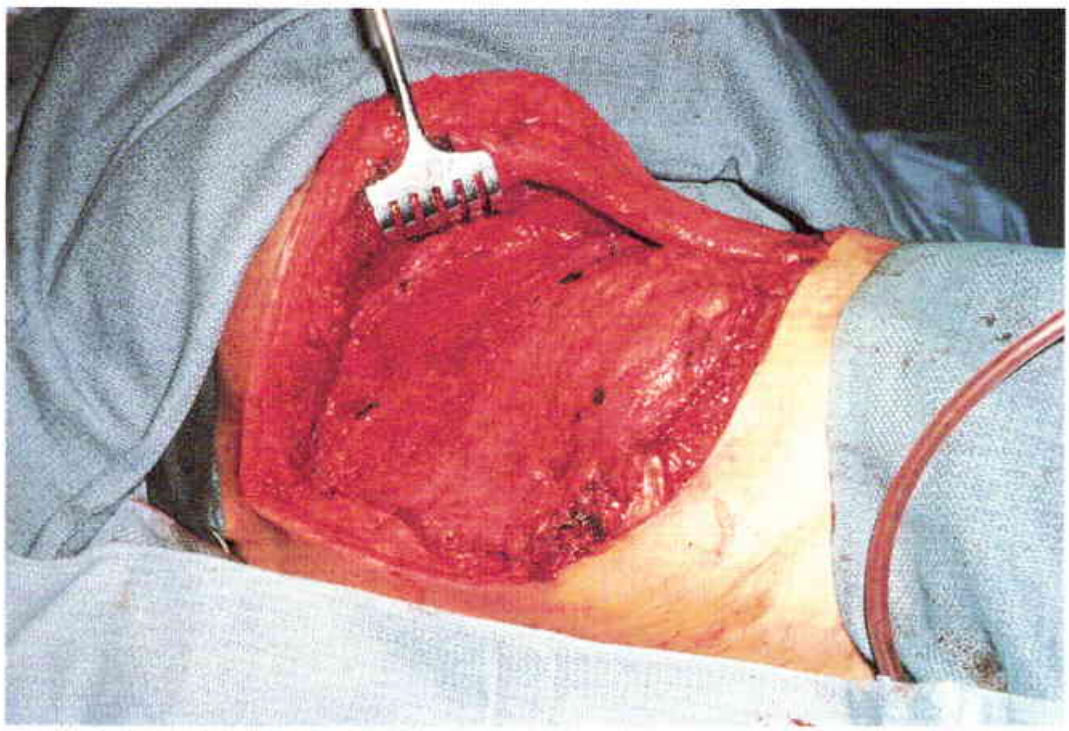
42
Seventy-eight-year-old man with a recurrent sarcoma of the posterior chest. The tumor recurred a few months following a limited local resection. (Case of P.G. Arnold)



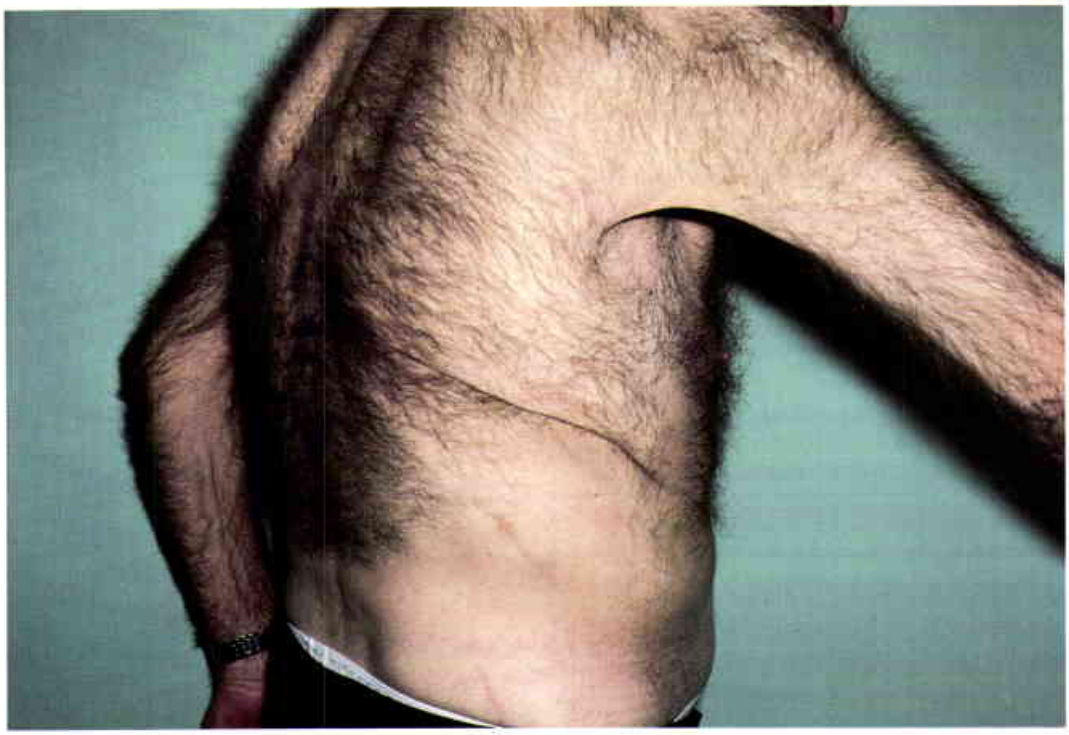
43
The tumor excision included three ribs.



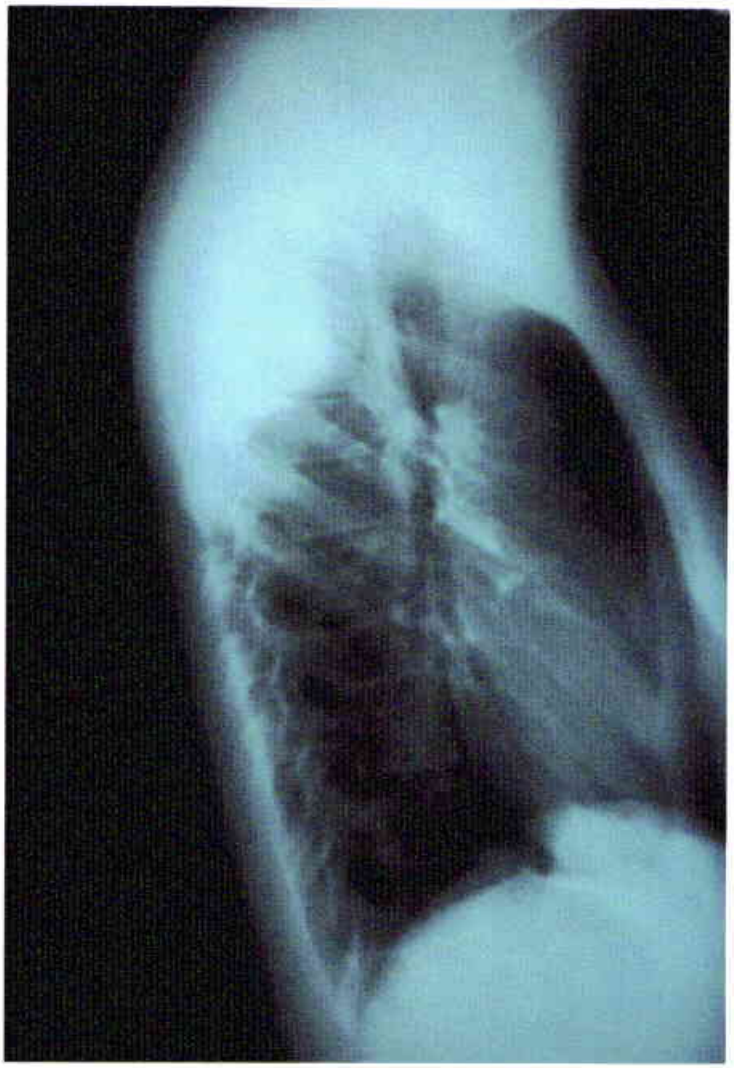
44
The skeletal defect was closed with Prolene® mesh.



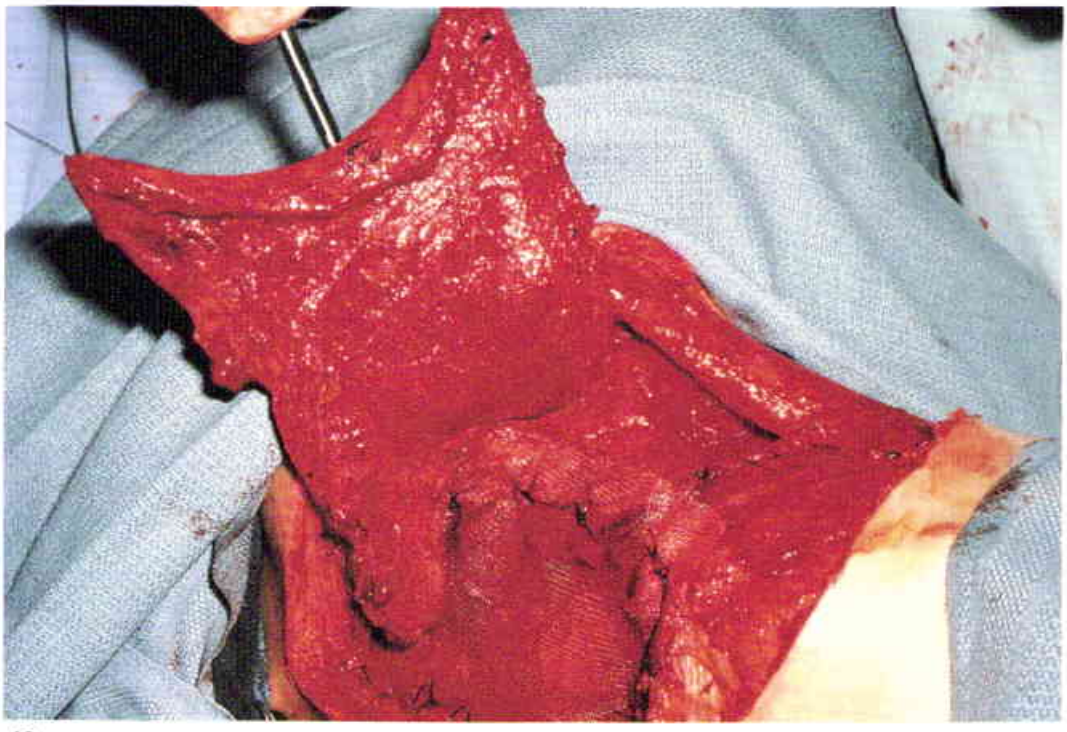
45
A latissimus muscle flap was rotated inferiorly to cover the Prolene® mesh. The skin was closed primarily over the chest wall repair.



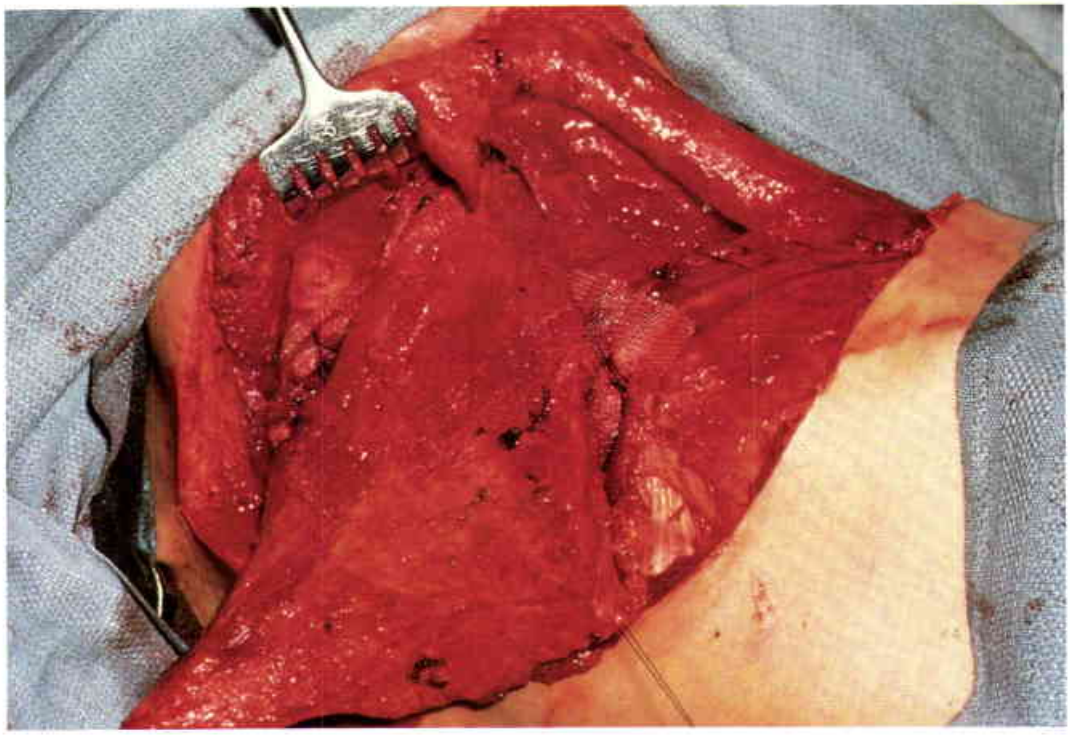
46
Healed wound at two years. The tumor has not recurred.



47
Recurrent osteoblastoma of the upper back in a thirty-year-old female, six months following a limited resection. (Case of P.G. Arnold)



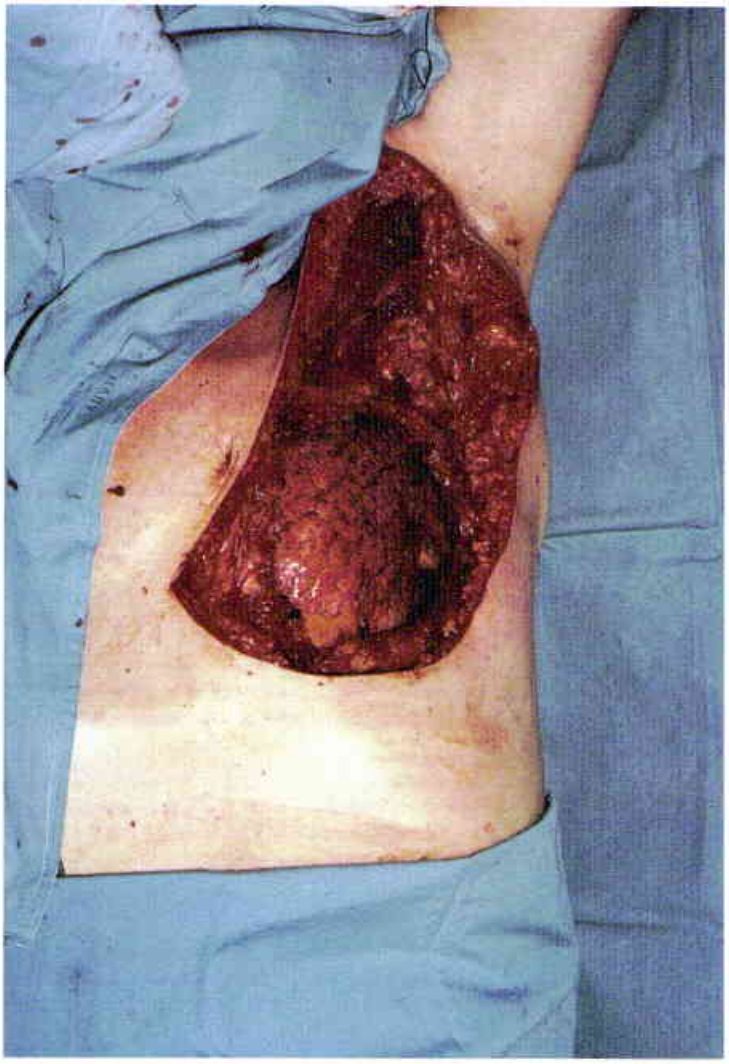
48
The full-thickness chest wall resection included five ribs and the paraspinous muscles. The skeletal defect was repaired with Prolene® mesh.



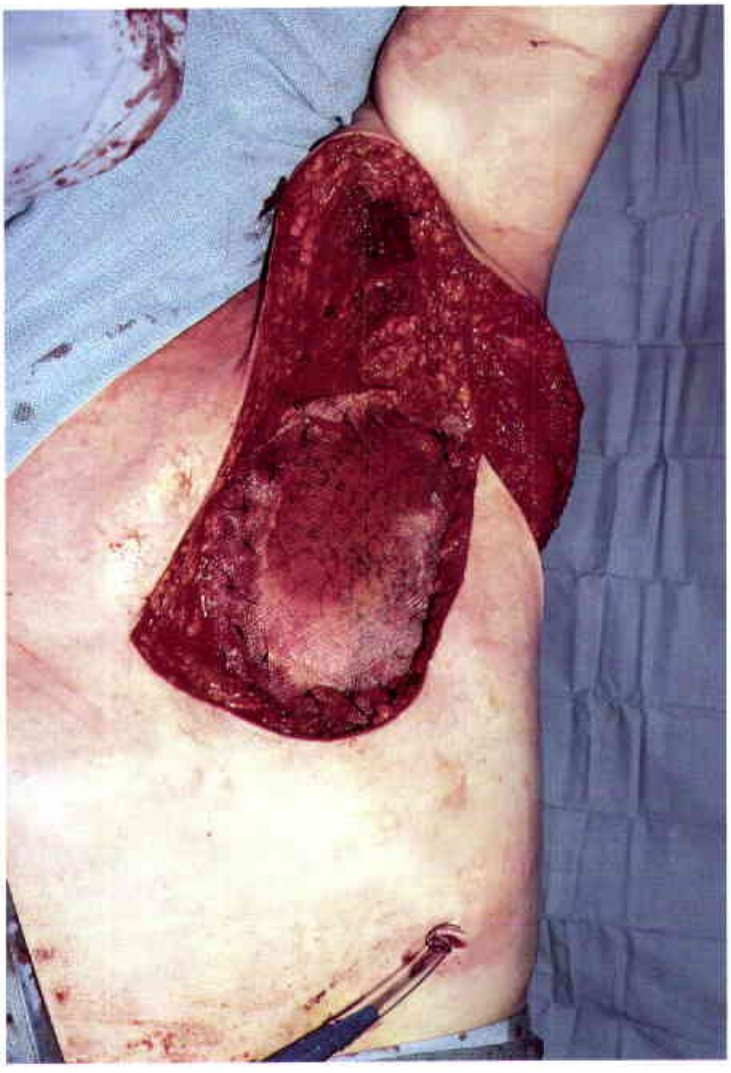
49
Latissimus dorsi muscle flap elevated to cover the Prolene® mesh.

50
Appearance at two years. Note the winging of the scapula which resulted from the removal of the paraspinous muscles.

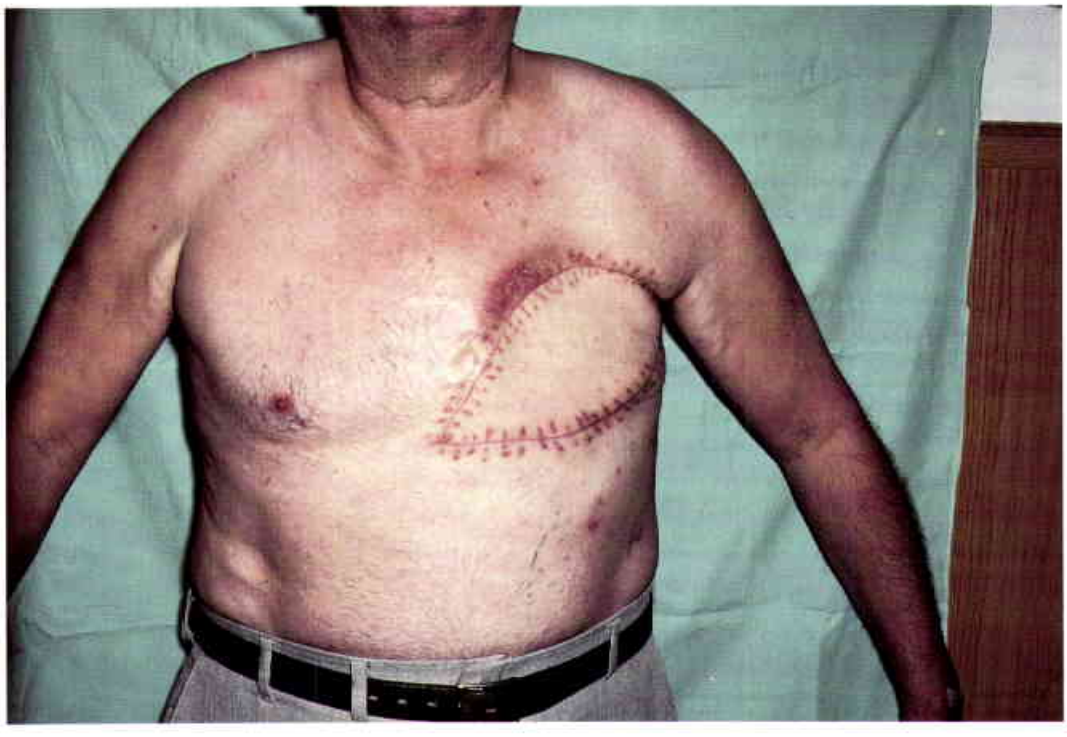
51
Recurrent osteosarcoma of the anterior chest wall in a fifty-six-year-old male. (Case of P.G. Arnold)



52
The full thickness resection of the tumor included four ribs.



53
Prolene® mesh stabilization of the chest wall.



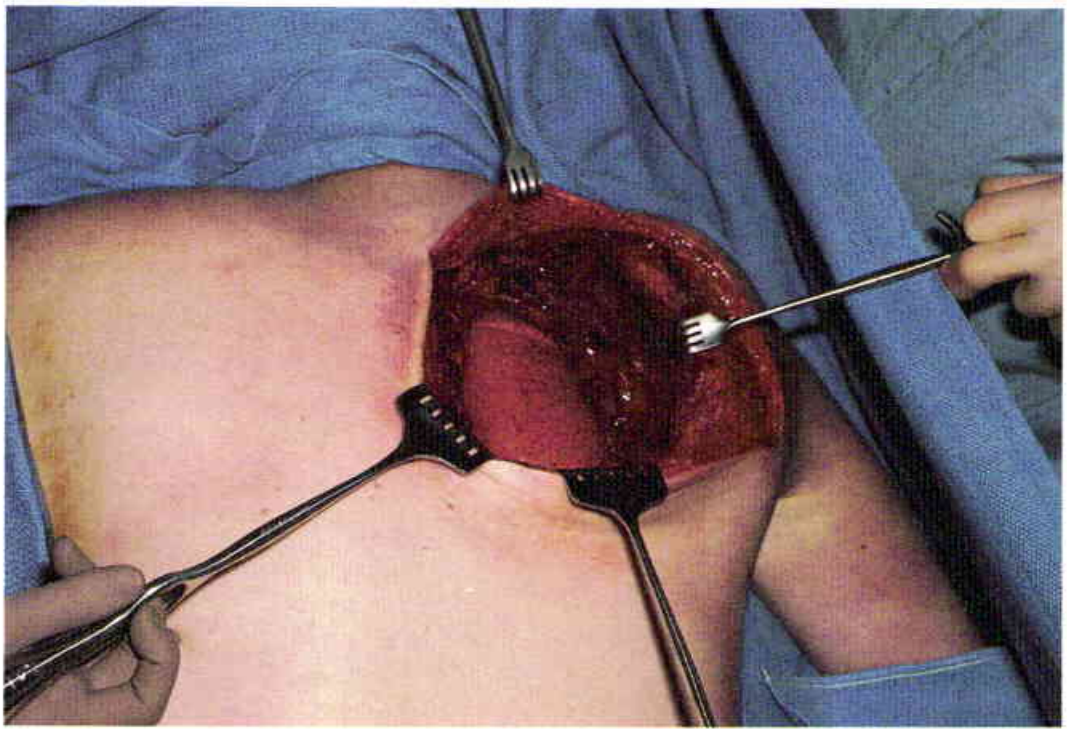
54
Healed latissimus myocutaneous flap at six weeks. The patient has survived nine years.

55
Painful osteoradionecrosis of the shoulder ten years following a radical mastectomy and massive irradiation. (Case of P.G. Arnold)

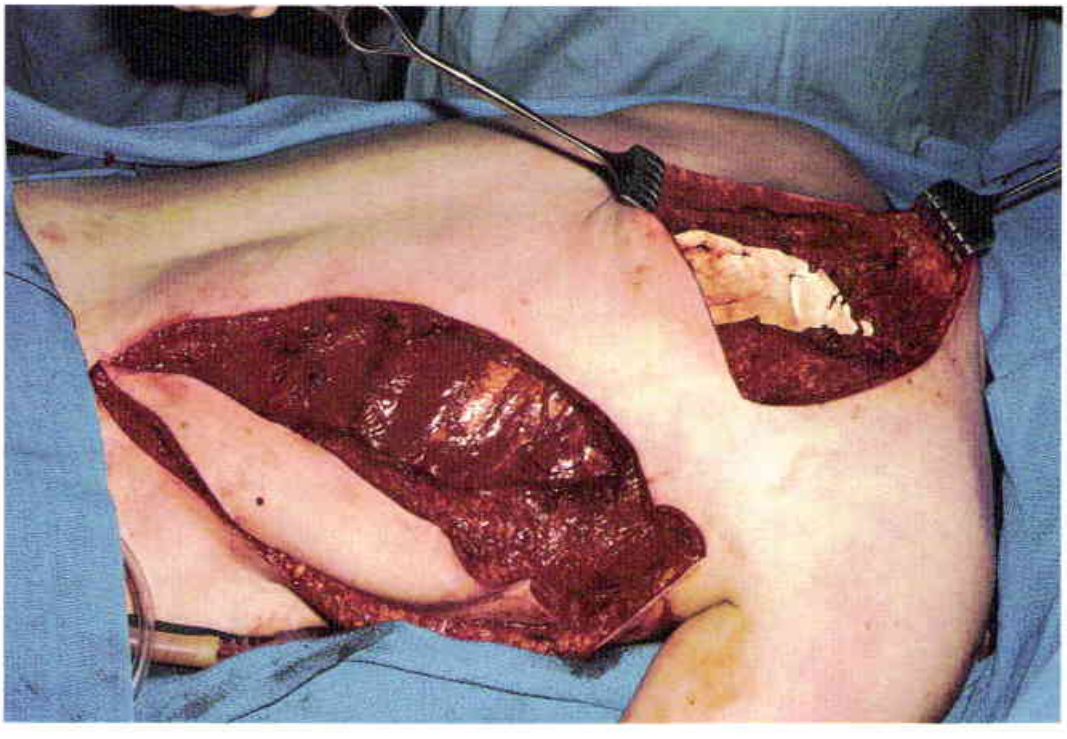
56
Because the thoracodorsal vessels had been heavily irradiated, the cutaneous segment of the flap was "delayed" in this very early case.

57
Latissimus flap transferred to the shoulder. A skin graft was necessary for the donor site closure. The resulting deformity is significant in this obese patient.

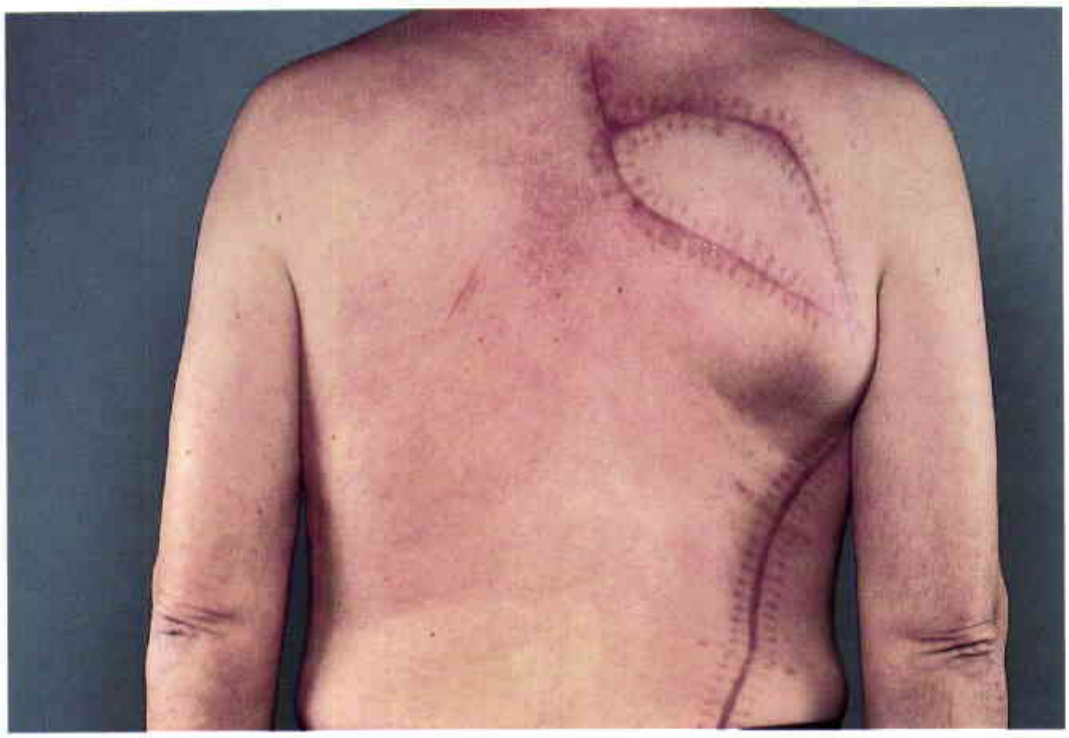
58
Healed flap six months following surgery.



59
Fifty-one-year-old man with a recurrent malignant fibrous histiocytoma of the upper back following a local resection. A wider resection included four ribs and the paravertebral and medial scapular muscles. (Case of P.G. Arnold)



60
Elevated latissimus myocutaneous flap. A Gortex® patch was used for the skeletal defect.

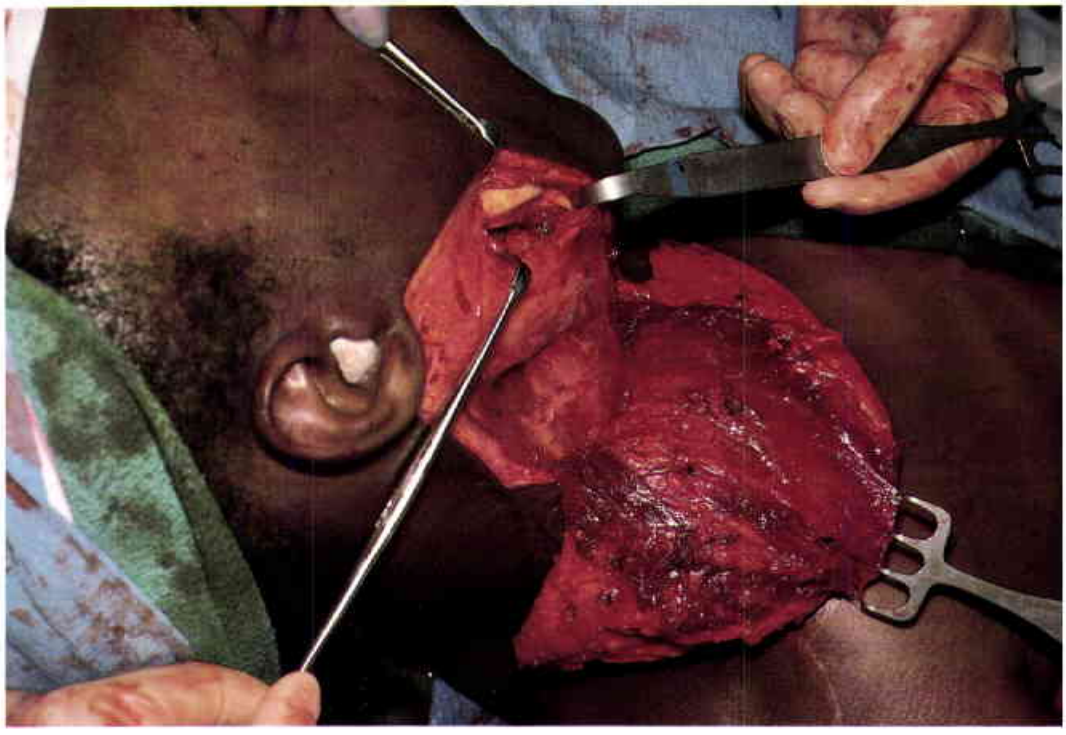


61
Healed flap at six months. The winging of the scapula was caused by the resection of its stablizing musculature.

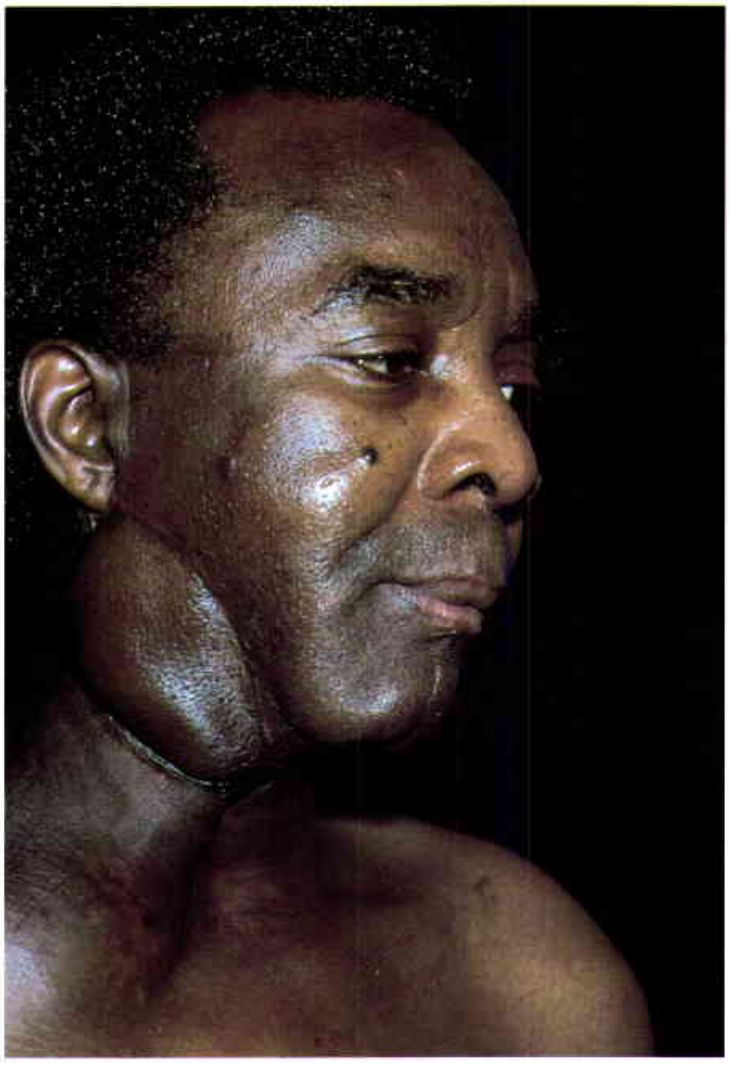
62
The postoperative shoulder motion is acceptable.

63
Fifty-five-year-old male following a composite resection and irradiation for a tonsillar carcinoma. The reconstructed mandible was grossly infected. A pectoralis "paddle" had previously been used. (Case of J.B. McCraw and W.P. Magee)

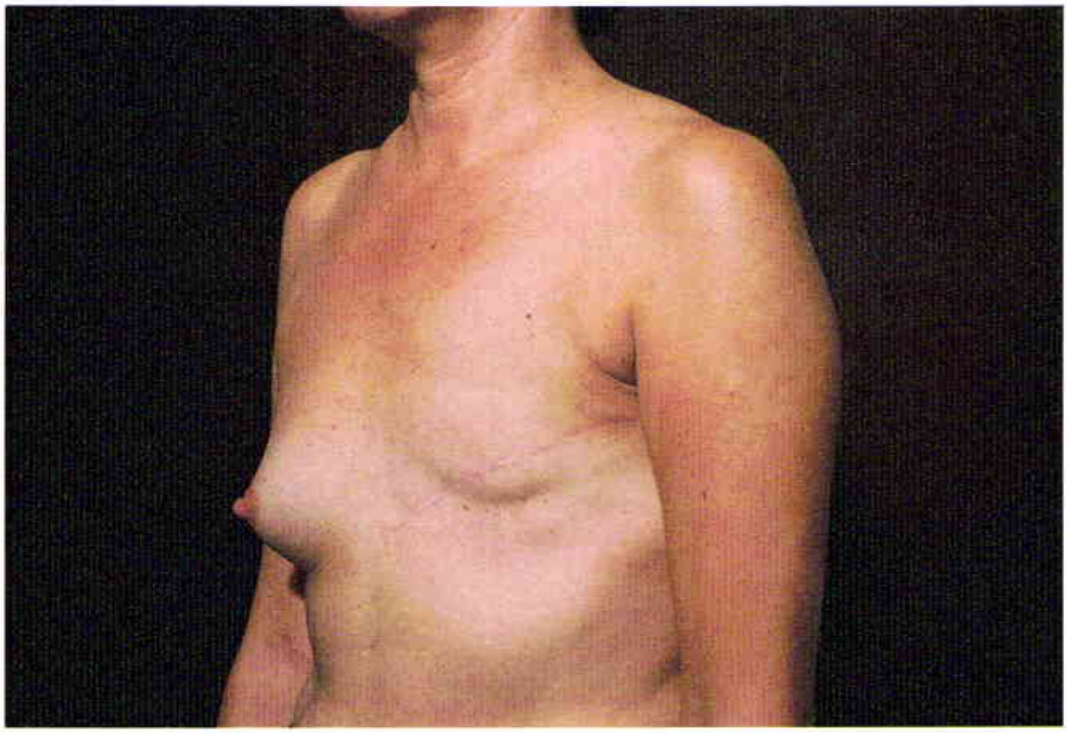
64
A low transverse latissimus dorsi skin "island" was chosen for the mandibular defect. An axillary counterincision was used to retrieve the latissimus muscle from beneath the intervening skin bridge.



65
Exposure of the infected mandible with the latissimus flap ready for inset.



66
Postoperative view of the inset flap at one year.

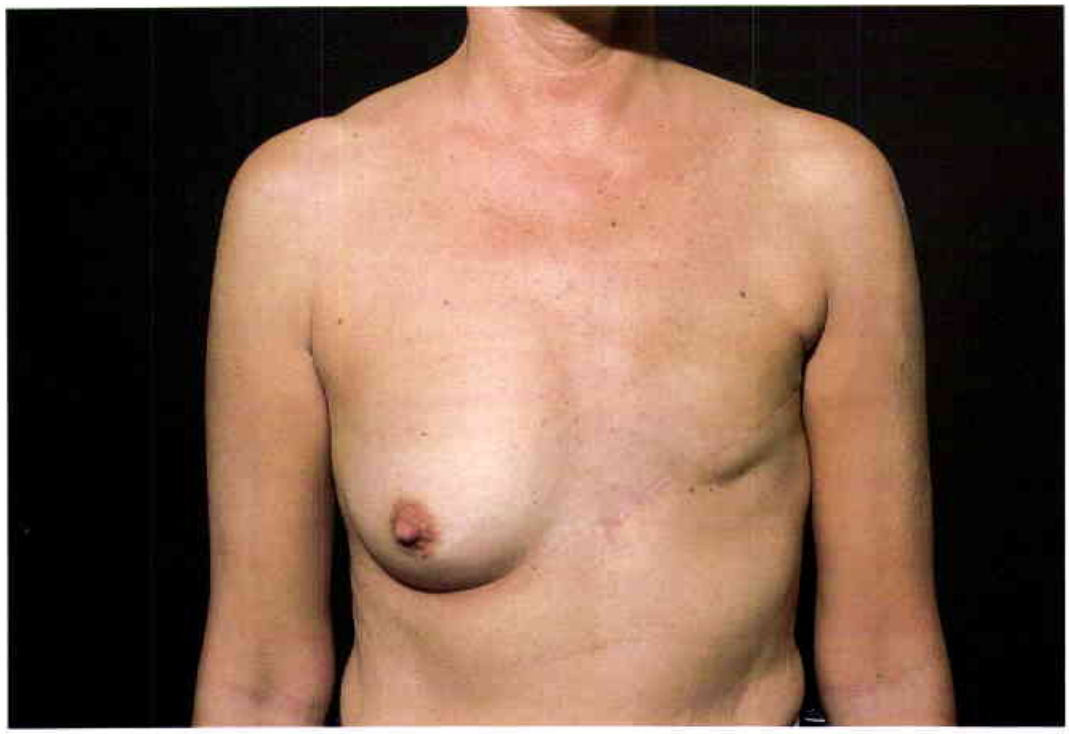


67

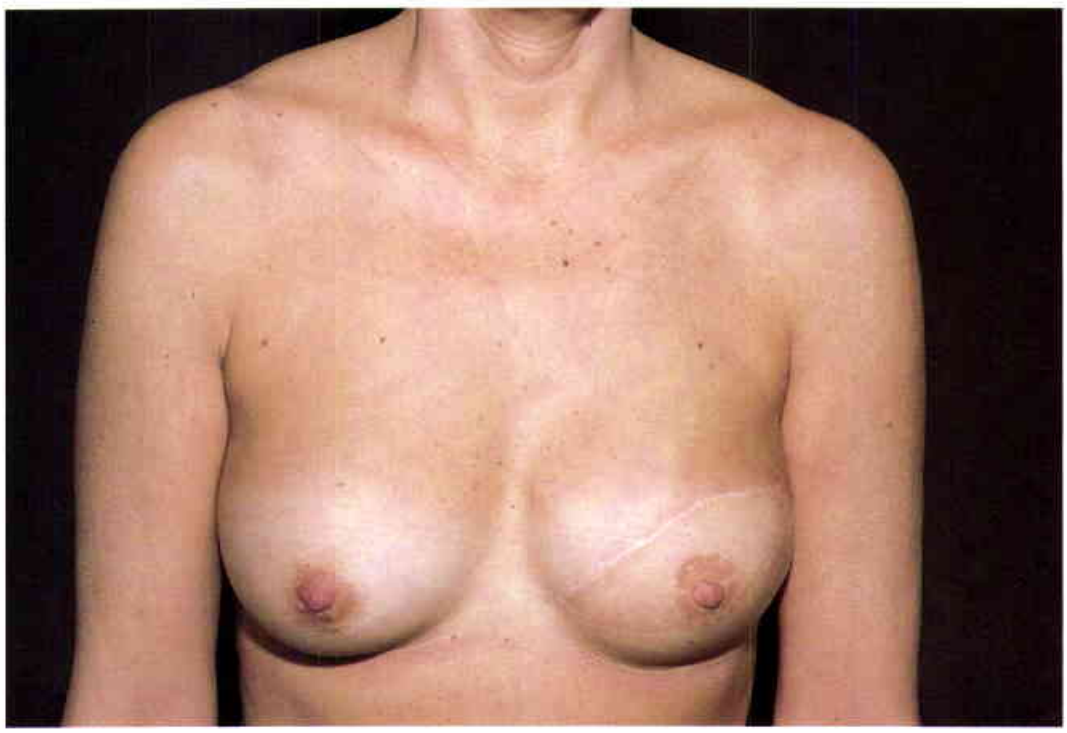
Thirty-six-year-old female six months following a modified mastectomy for a poorly differentiated inner quadrant adenocarcinoma. Pathological examination demonstrated seven of ten involved axillary nodes as well as positive internal mammary nodes. The patient insisted on an early reconstruction because of the poor prognosis. (Case of J.B. McCraw)

68

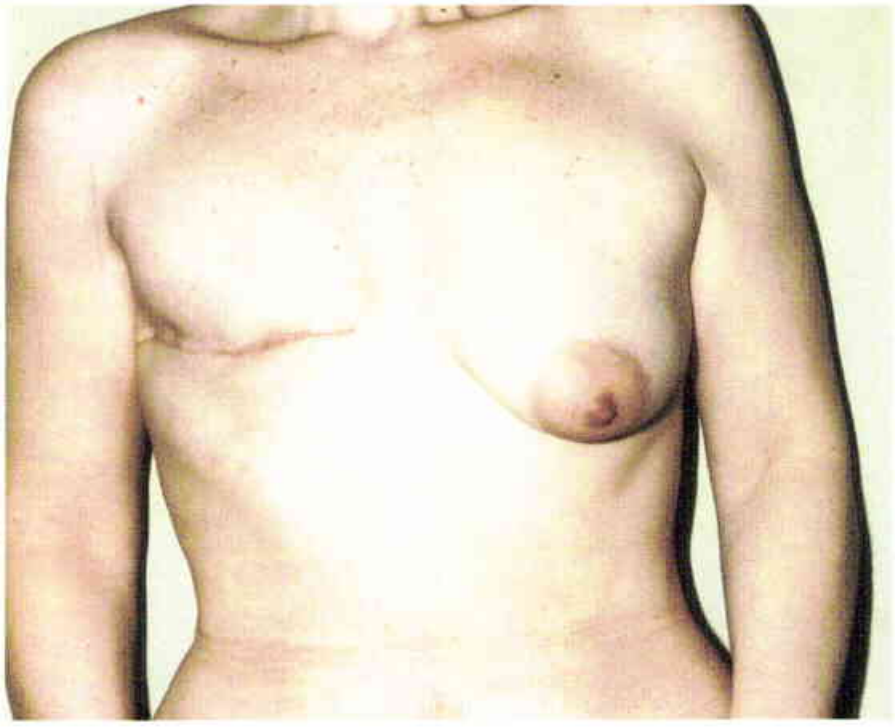
A left latissimus breast reconstruction and a right subpectoral augmentation were done seven months following the mastectomy. The nipple-areolar reconstruction was completed one month later.



69
Preoperative frontal view. The excellent skin cover and the low and oblique incision were favorable for a latissimus breast reconstruction. The pectoralis muscle was intact and innervated.

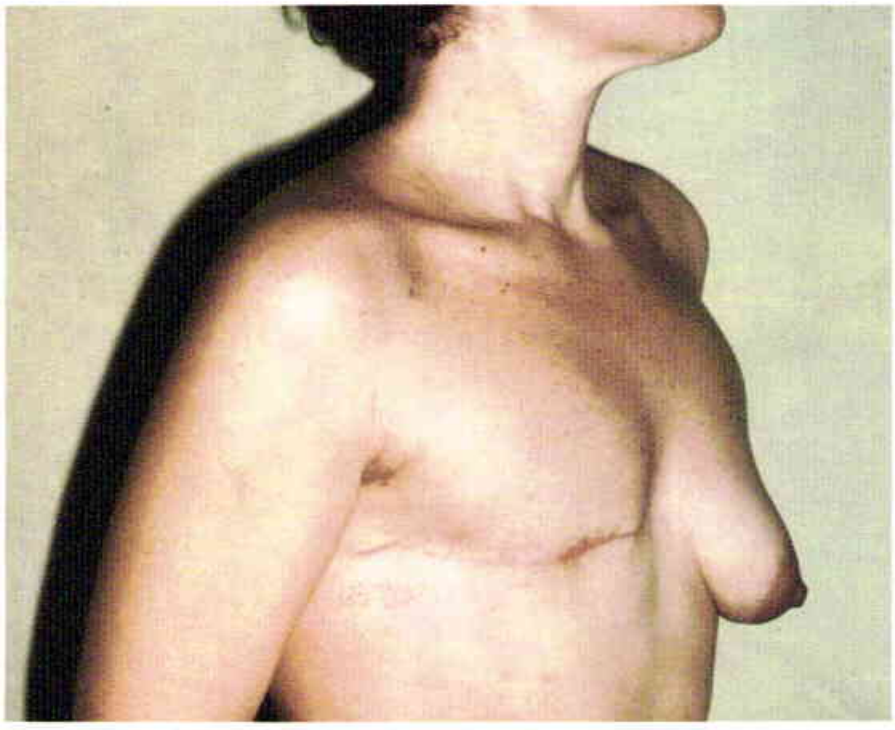


70
Postoperative view at two and one-half years. Both breasts have remained soft. The patient has survived for five years.



71

Forty-eight-year-old female who had undergone a right modified mastectomy for lobular carcinoma. A "mirror image" biopsy of the opposite breast was positive for in situ disease. (Case of P.G. Arnold)



72

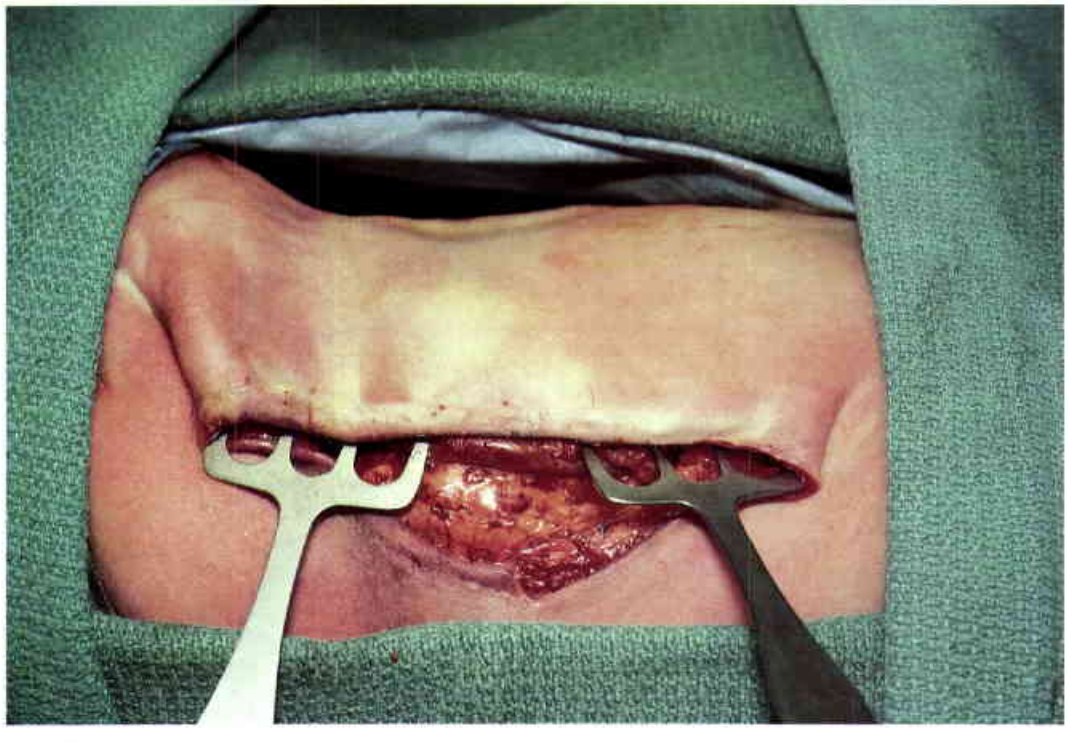
The lower half of the pectoralis major was denervated by the dissection of the pectoralis minor.

73
One year following a right latissimus dorsi breast reconstruction and a left prophylactic mastectomy and immediate subpectoral reconstruction.

74
The contour and shape of the right latissimus breast reconstruction is better than the left subpectoral breast reconstruction.

75
This six-hour-old infant was born with a large meningomyelocele. (Case of J.B. McCraw and J. Penix)

76
Defect remaining following the dural dissection.



77, 78

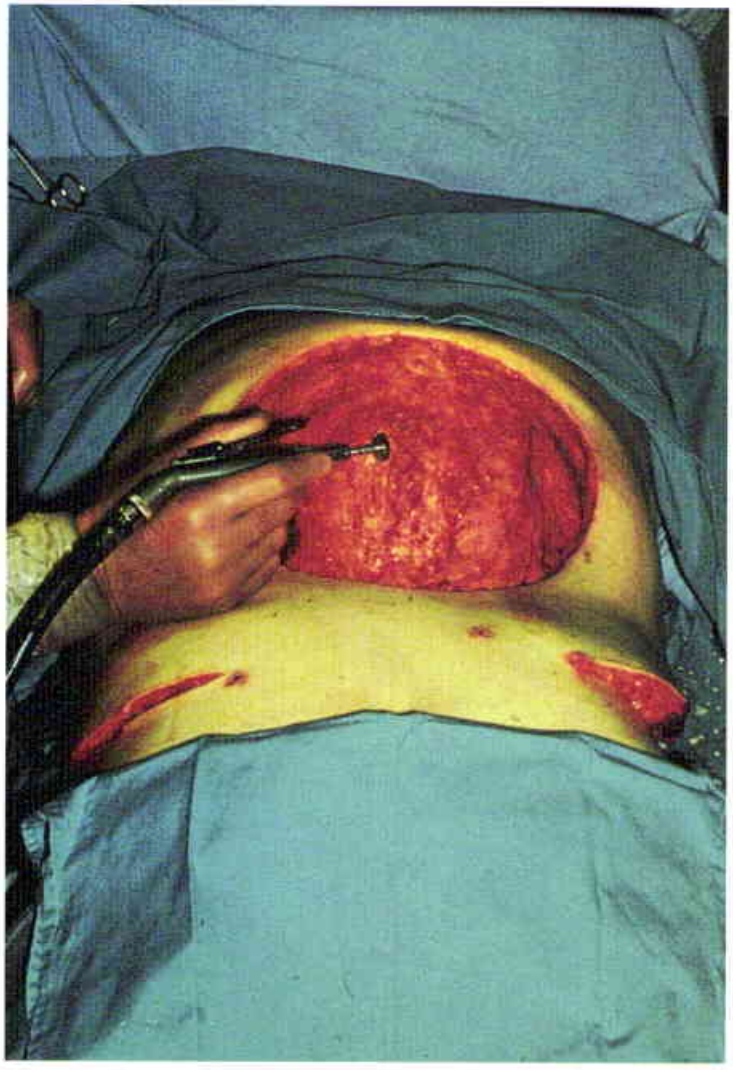
Following the dural closure, both latissimus dorsi muscles were elevated as composite flaps. Division of the fascial attachments of the latissimus muscle to the anterior chest wall allows the composite flaps to advance to the posterior midline.

79, 80

The latissimus muscles and the overlying skin of the flaps were closed in separate layers. The patient is able to walk with braces.

81
This forty-seven-year-old man had previously undergone a resection of a massive spinal cord tumor. The dural defect was skin grafted and heavily irradiated. He was being treated for meningitis which was the result of multiple CSF fistulas in the skin graft. (Case of P.G. Arnold)

82
Posterior view of the dural skin grafts. Bilateral latissimus dorsi myocutaneous flaps are outlined.



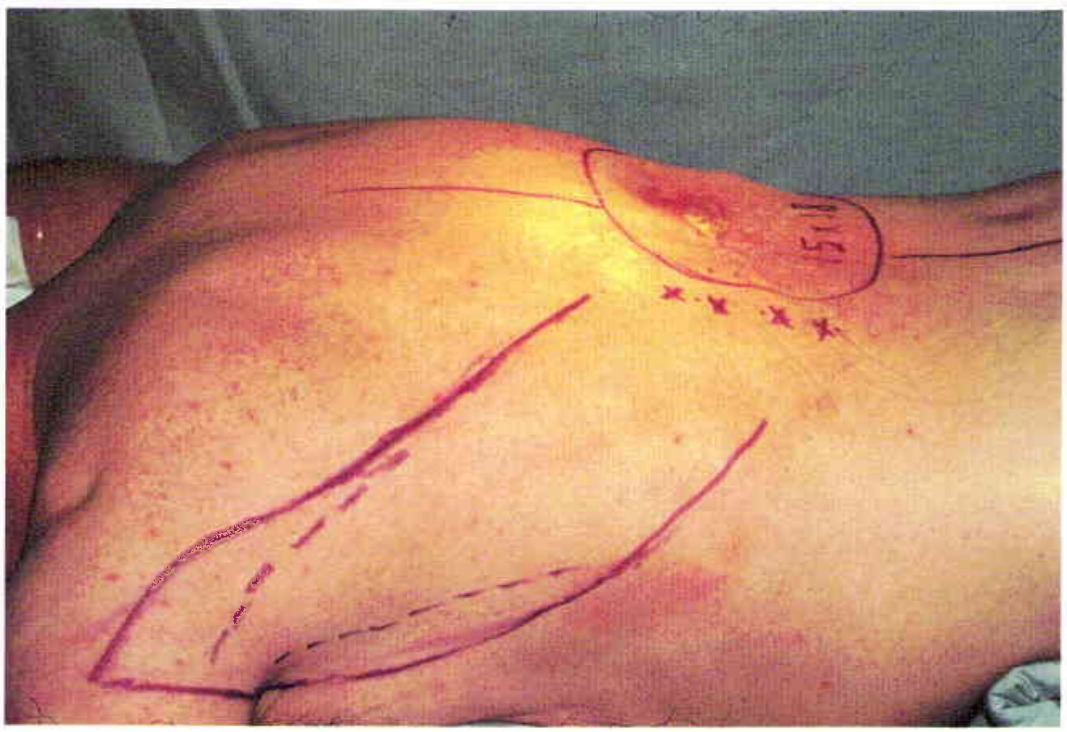
83
The dural skin graft was removed with a motorized wire brush following the elevation of the bilateral latissimus myocutaneous flaps.

84
The latissimus dorsi myocutaneous flaps are demonstrated with the inferior "backcuts." The flaps were elevated two days earlier at the time of the initial debridement. Neither humeral insertion was divided.

85
The latissimus flaps were approximated in the midline to provide complete muscle coverage of the dura. The flanks were grafted in a delayed fashion.

86
Three years following surgery. The muscular closure accomplished a resolution of the CSF leaks and may have saved the patient from a lethal course of meningitis.

87
Fifty-five-year-old man with a liposarcoma which had been treated with a wide excision and seven thousand rads of external beam irradiation. The irradiation ulcer was caused by a breakdown of recurrent tumor. (Case of J.B. McCraw and J. Penix)



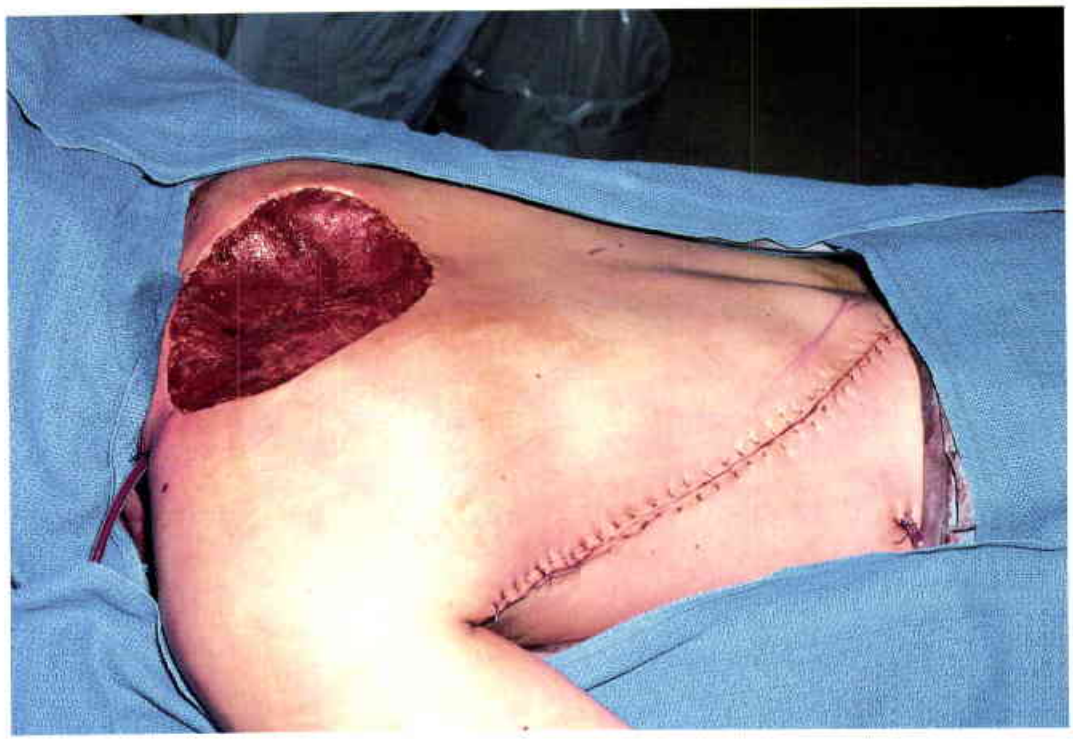
88
Outline of a "reversed" latissimus myocutaneous flap. The posterior perforators are marked with X's. A fifteen by eighteen centimeter tumor resection is planned.

89
The "reversed" latissimus dorsi flap is elevated to the margin of the left paraspinous muscles. The thoracodorsal vessels and the latissimus dorsi muscular insertion have already been divided.

90
The flap was rotated over a 130 degree arc on the posterior perforators. A small split-thickness skin graft was placed on the serratus anterior muscle just above the base of the flap. The patient has been free of disease and ulceration for the eight years following this operation.

91
Twelve-year-old female with rhabdomyosarcoma of the interscapular region. The wide excision included skin and the underlying paravertebral muscles. (Case of P.G. Arnold)

92
The left latissimus dorsi muscle is elevated on its thoracodorsal vessels to cover the exposed thoracic spine.



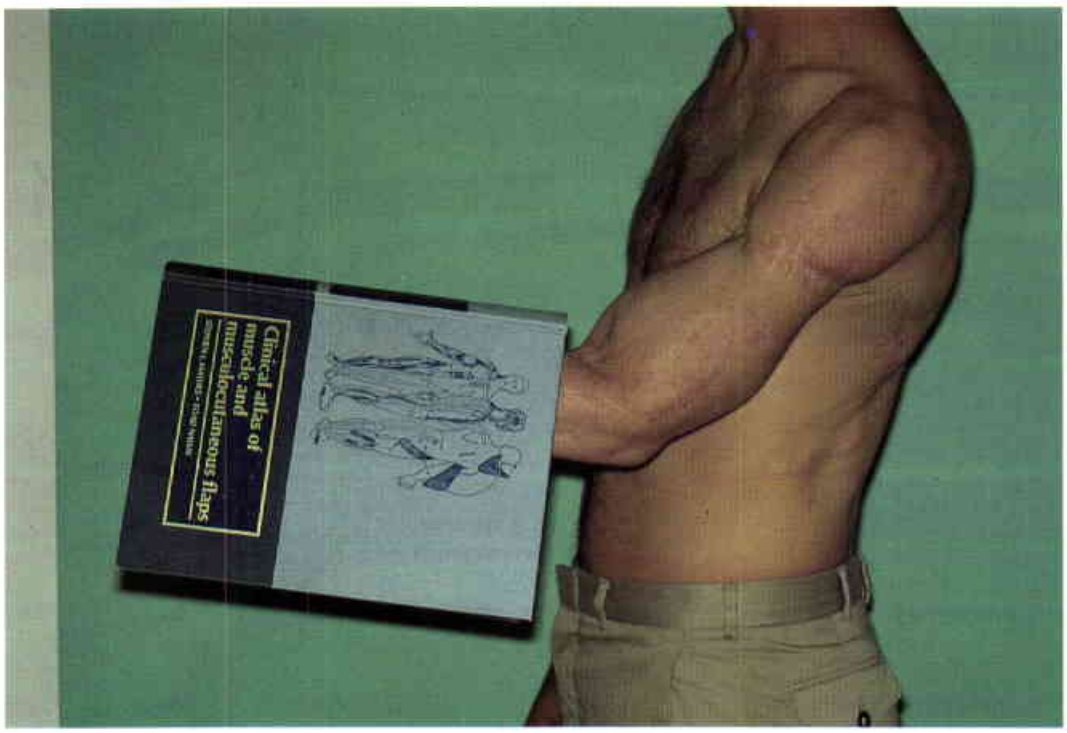
93
The latissimus muscle flap has been tunneled beneath the upper back skin. The donor site was closed directly.

94
Appearance six weeks following the reconstruction.

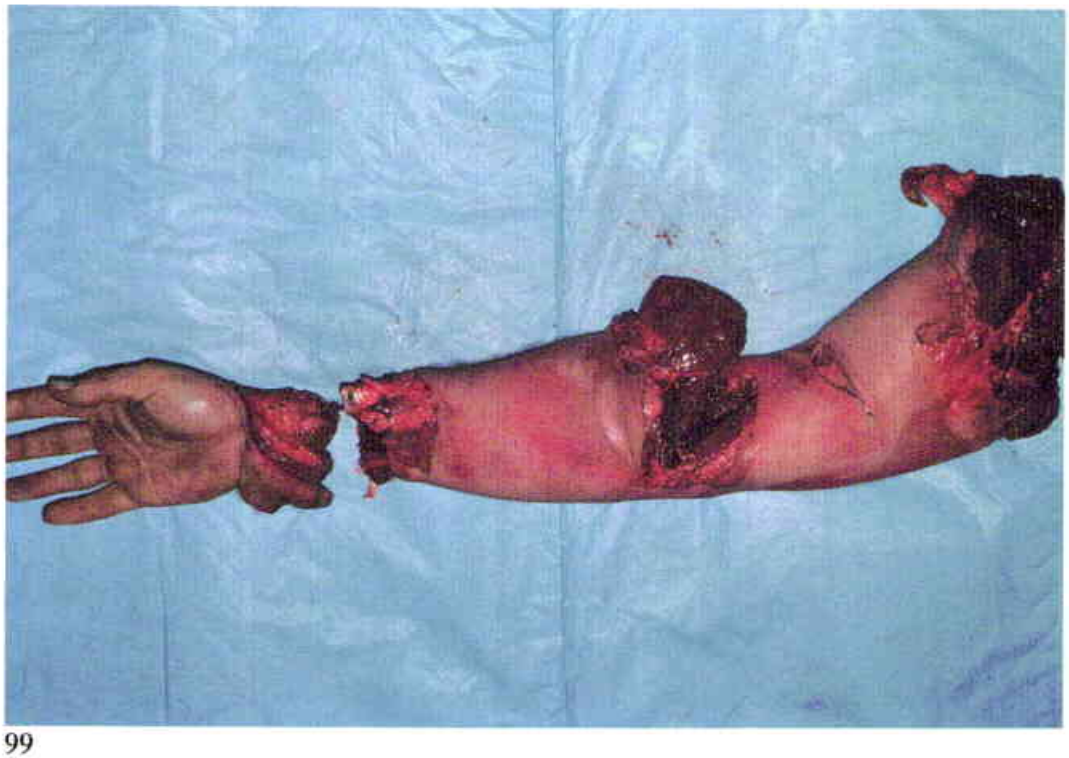
95
This twenty-year-old male presented one year following a complete amputation of the arm at the shoulder and a successful replantation. A latissimus myocutaneous flap will be used to provide surface replacement of the lost axillary and arm skin, functional reconstitution of the lost biceps muscle, and vascularized coverage of nerve grafts to the hand. (Case of P.G. Arnold)

96
The latissimus flap is readied for transfer into the arm.

97
Nerve grafting was completed at the time of the latissimus muscle flap transfer to the biceps muscle.

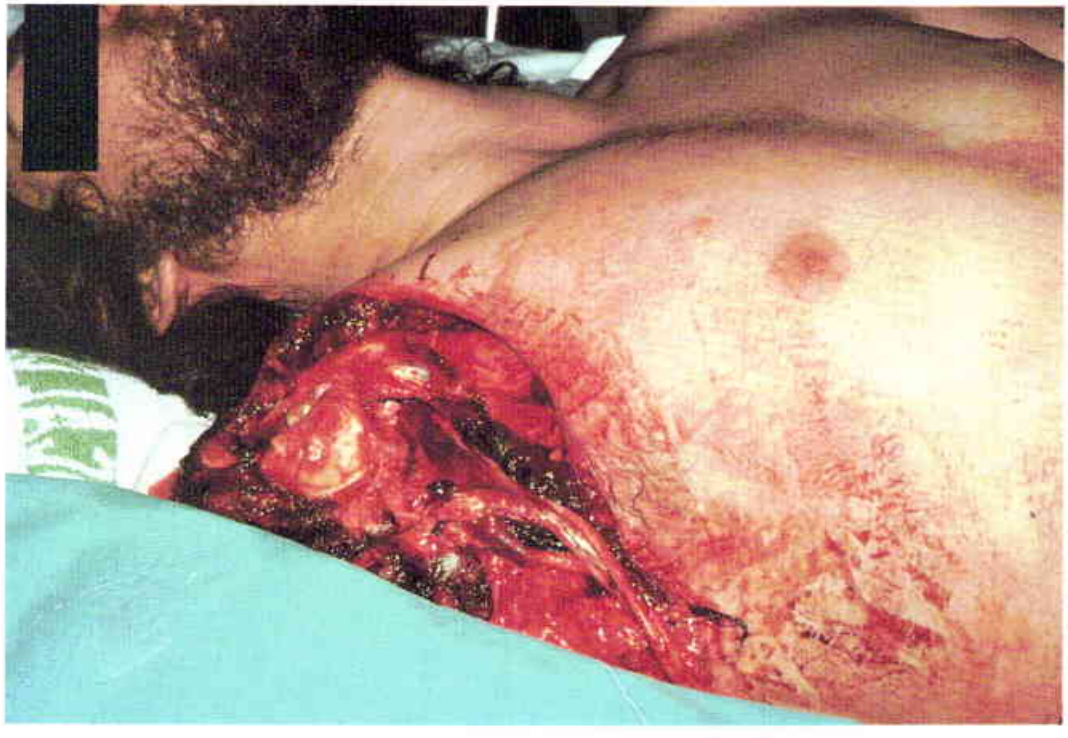


98
The forcefulness of elbow flexion is demonstrated eighteen months following the latissimus muscle transfer to the biceps brachii. He is able to lift the fine book of our friends Steve and Foad.



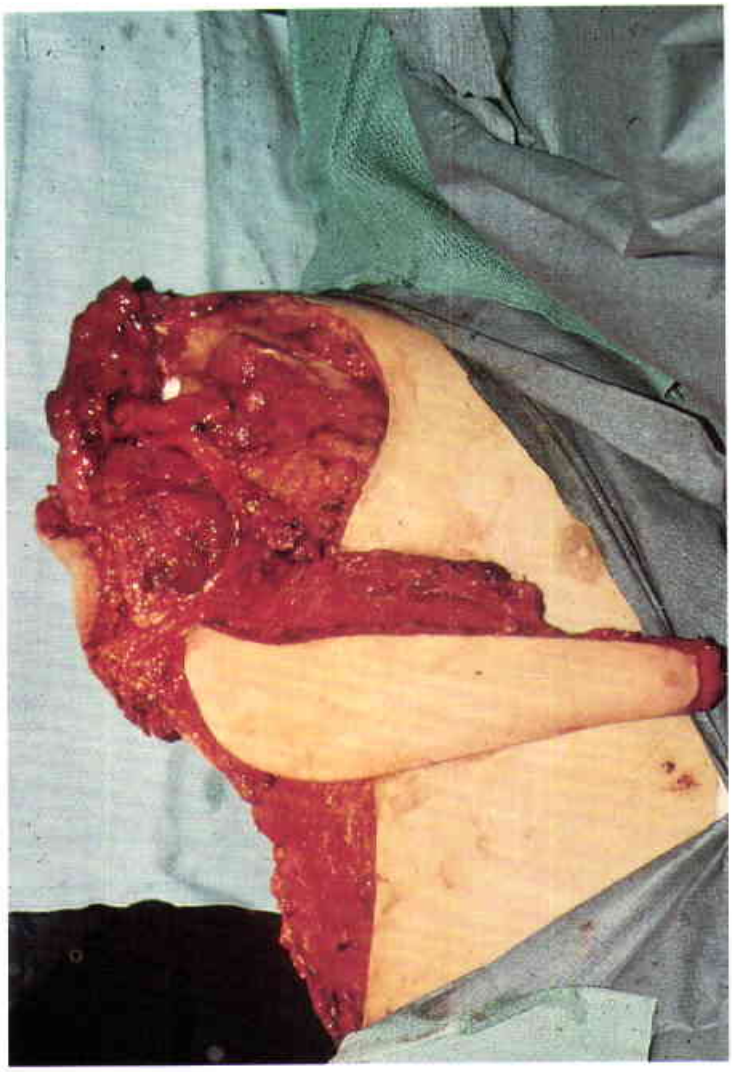
99

Twenty-five-year-old male with a massive avulsion injury of his right arm from an industrial windlass. A replantation was only briefly considered. (Case of J.B. McCraw)

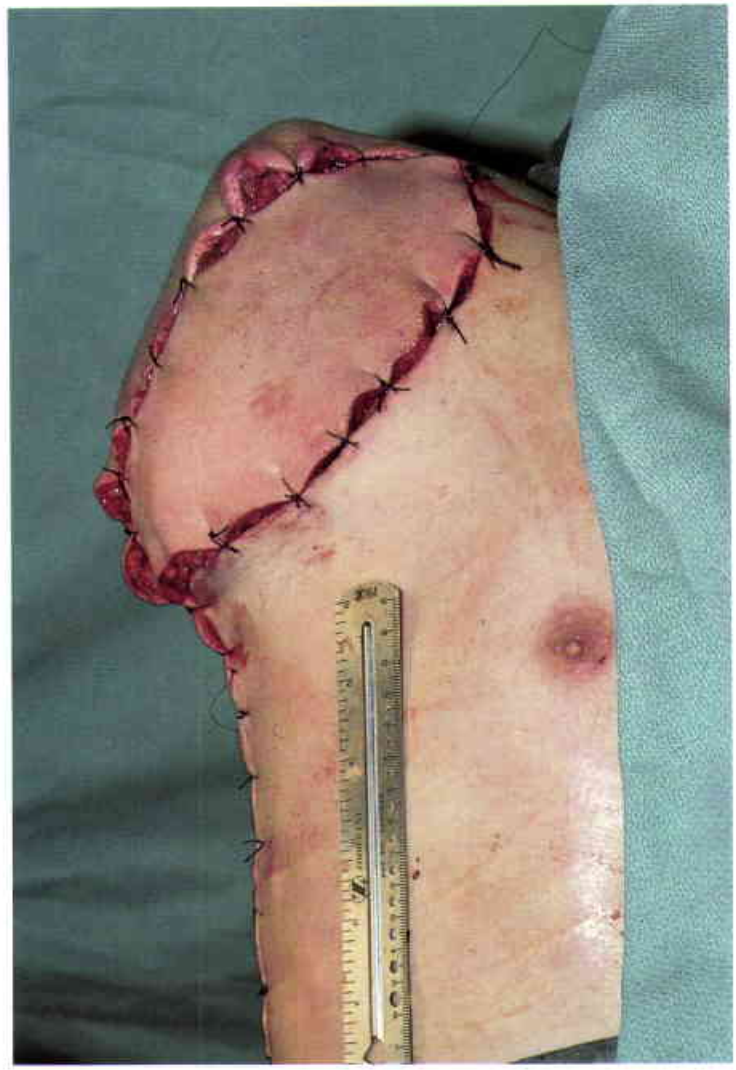


100

The amputation site became grossly infected and the clavicle and glenoid fossa were exposed.



101
A latissimus myocutaneous flap was designed to provide total muscle coverage of the infected shoulder wound.



102
This early case demonstrated that the latissimus myocutaneous flap could withstand the significant ''crossing tension'' which was produced by these temporary 2-0 silk sutures.

103
The wound healed primarily and the patient was discharged from the hospital on the fifth postoperative day. Had a skin graft been used, approximately three inches of the clavicle would have protruded from the chest wall.

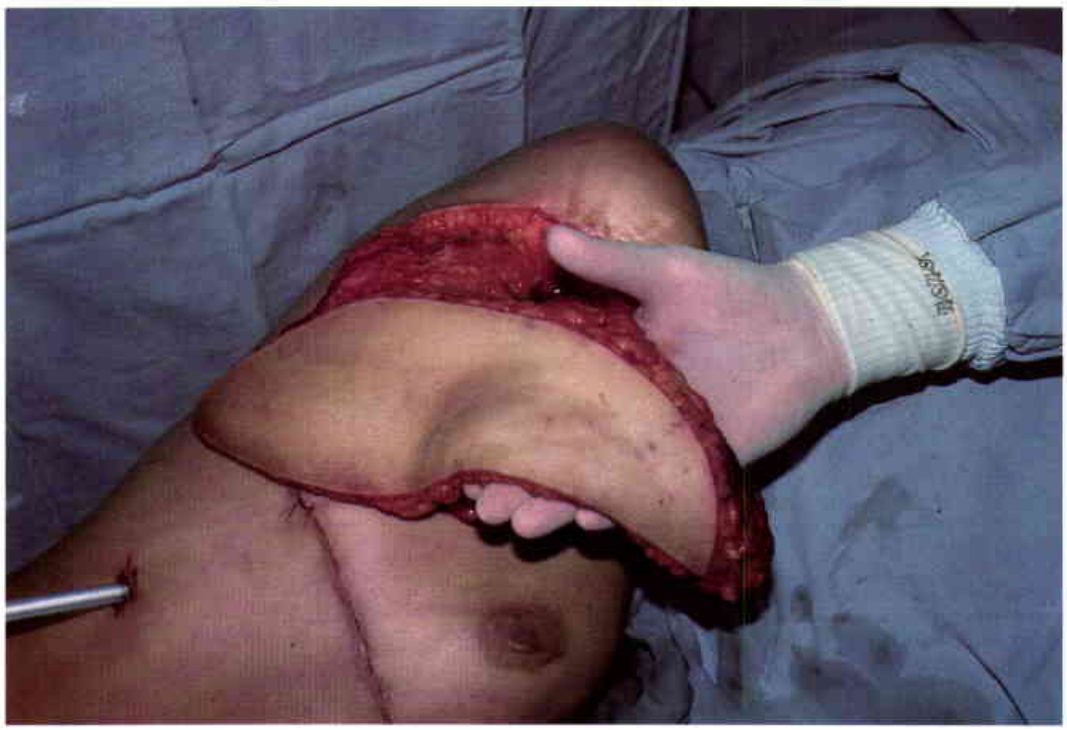
104
The excellent soft tissue coverage enabled the patient to tolerate a heavy arm prosthesis.

105
Young man with a high amputation from a grain auger injury. Maintenance of stump length was important for the use of an above-elbow prosthesis. A reamputation near the axilla would have been required to cover the exposed bone. (Case of P.G. Arnold)

106
Latissimus dorsi myocutaneous flap coverage of the exposed humerus.

107
Postoperative view at five months. The full length of the stump was maintained.

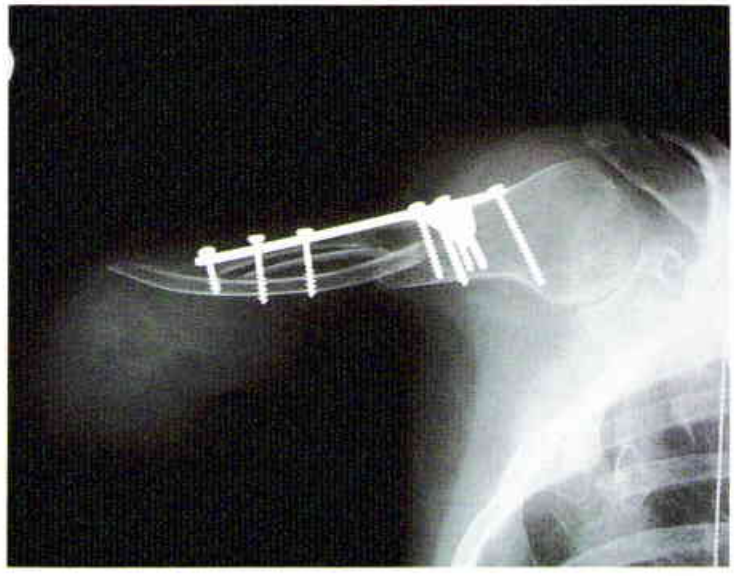
108
Austrian woman with a short above-elbow amputation stump following an auto accident. The patient had no use of the right upper extremity. (Case of C. Papp)



109
Combined latissimus and serratus myocutaneous flap which also contained the sixth and seventh ribs and intercostal muscles.

110

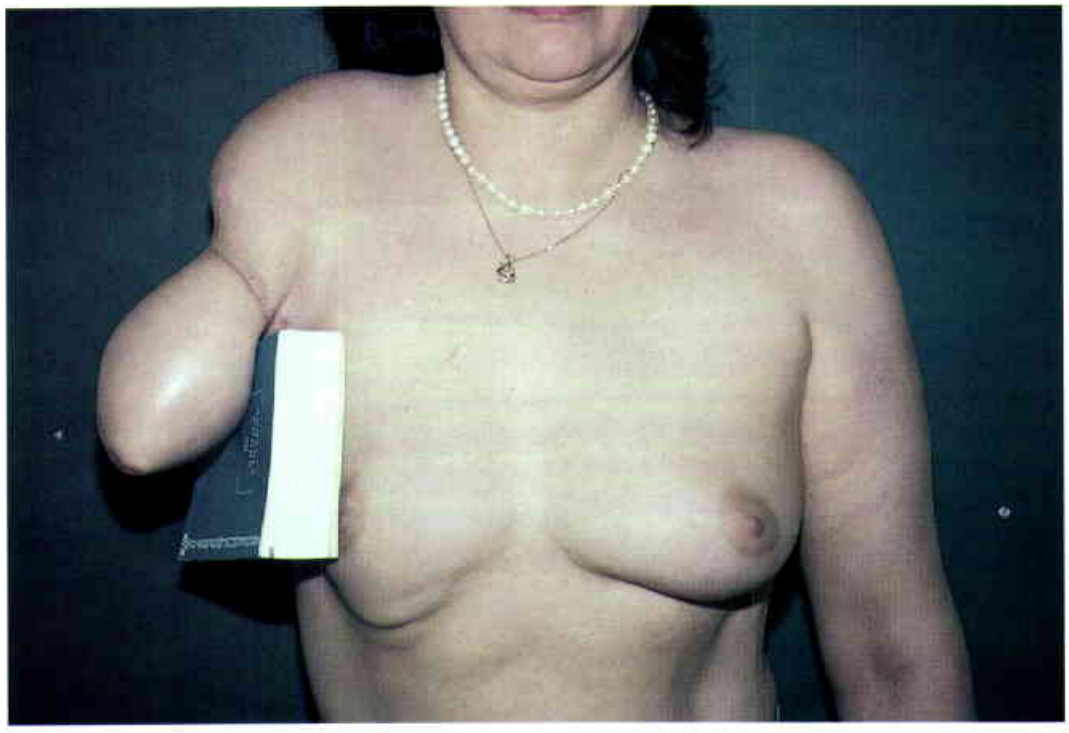
The excursion of the composite flap was tethered by the intercostal vessels which were divided. The blood supply to the intercostal muscles and ribs was sustained by the attached chest wall muscles. To maintain the integrity of the intercostal vessels the fourth and fifth ribs could have been used instead of the sixth and seventh ribs.



111

X-ray comparison of the preoperative and postoperative amputation stump.

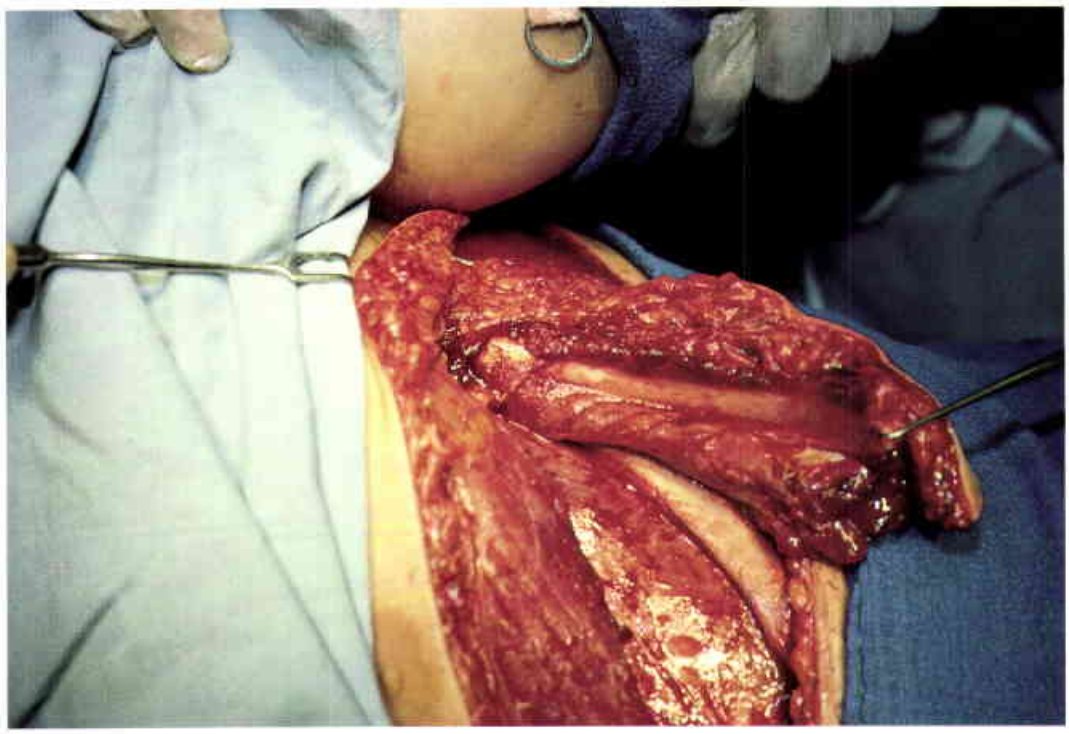
112
Three months following the first procedure, a Z-plasty was performed to reduce lymphadema.



113
The patient is able to hold large objects with the stump and can comfortably wear a prosthesis.

114, 115

Complex injury to the triceps muscle with avulsion of the radial nerve. A 7.5 centimeter segmental loss of the humerus is seen on the x-ray. (Case of C. Papp)

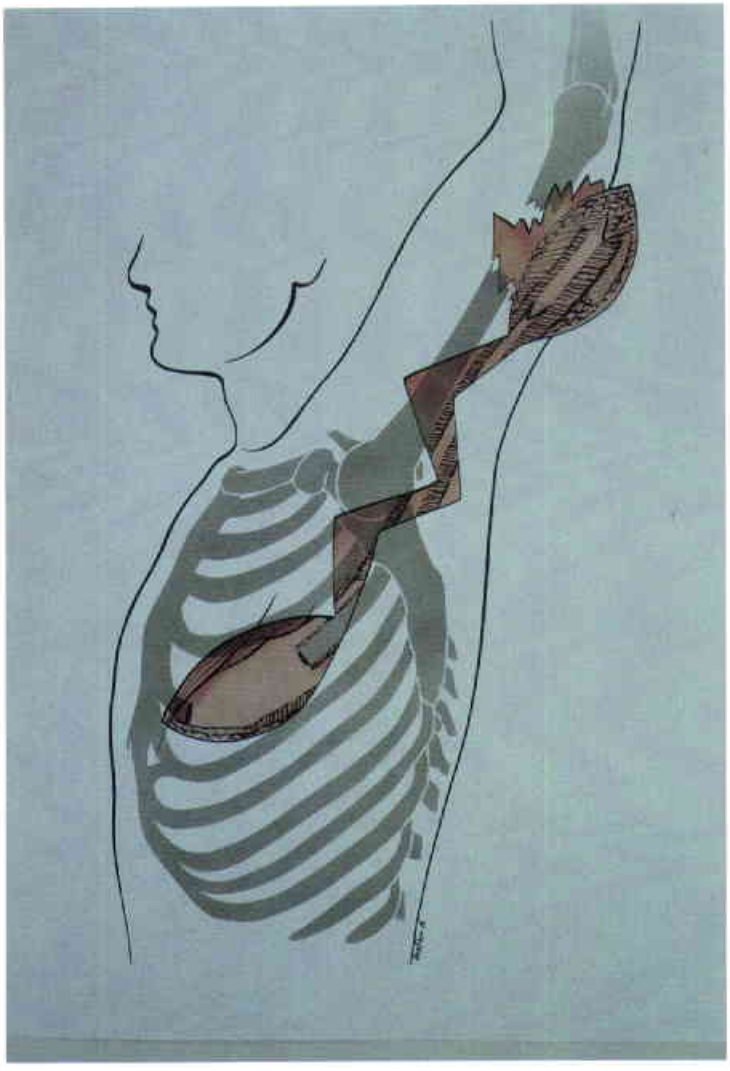


116, 117

Elevated fourth rib with its adjacent intercostal muscles. The overlying skin was carried with the intercostal flap to replace the lost arm skin.

118, 119

X-ray comparison of the healing rib interposition flap at two months and at two years.



120, 121
Illustration of the route of the "island" intercostal myocutaneous flap. The successful repair of the segmental defect of the radial nerve and the humerus enabled the patient to return to normal activities. He is shown lifting five kilograms.

LATISSIMUS

Ali, S., Watson, J.S., and Bihari, J. "Use of the latissimus dorsi myocutaneous flap for total pharyngeal reconstruction." *J. Laryngol. Otol.* 96(9): 837, 1982.

Amoroso, P.J. and Angelats, J. "Latissimus dorsi myocutaneous flap in Poland syndrome." *Ann. Plast. Surg.* 6(4): 287, 1981.

Arianayagam, C. "Latissimus dorsi flap for the head and neck (letter)." *Plast. Reconstr. Surg.* 73(1): 156, 1984.

Arnold, P.G. and Pairolero, P.C. "Chest wall reconstruction: experience with 100 consecutive patients." *Ann. Surg.* 199(6): 725, 1984.

Asko-Seljavaara, S., Pitkanen, J., and Sundell, B. "Microvascular free flaps in early reconstruction of burns in the hand and forearm: case reports." *Scand. J. Plast. Surg.* 18(1): 139, 1984.

Asko-Seljavaara, S., Ryynanen, A., and Sundell, B. "Latissimus dorsi musculocutaneous flap used as a pedicle on free microvascular graft." *Ann. Chir. Gynaecol.* 71(1): 44, 1982.

Axer, A., Segal, D., and Elkon, A. "Partial transposition of the latissimus dorsi: a new operative technique to restore elbow and finger flexion." *J. Bone Joint Surg.* (Am.) 55(6): 1259, 1973.

Bailey, B.N. and Godfrey, A.M. "Latissimus dorsi muscle free flaps." *Br. J. Plast. Surg.* 35: 47, 1982.

Baker, S.R. "Closure of large orbital-maxillary defects with free latissimus dorsi myocutaneous flaps." *Head Neck Surg.* 6(4): 828, 1984.

Barrow, D.L., Nahai, F., and Fleischer, A.S. "Use of free latissimus dorsi musculocutaneous flaps in various neurosurgical disorders." *J. Neurosurg.* 58(2): 252, 1983.

Bartlett, S.P., May, J.W., Jr., and Yaremchuk, M.J. "The latissimus dorsi muscle: a fresh cadaver study of the primary neurovascular pedicle." *Plast. Reconstr. Surg.* 67(5): 631, 1981.

Barton, F.E., Jr., Spicer, T.E., and Byrd, H.S. "Head and neck reconstruction with the latissimus dorsi myocutaneous flap: anatomic observations and report of 60 cases." *Plast. Reconstr. Surg.* 71(2): 199, 1983.

Bianchi, A., Doig, C.M., and Cohen, S.J. "The reverse latissimus dorsi flap for congenital diaphragmatic hernia repair." *J. Pediatr. Surg.* 18(5): 560, 1983.

Biggs, T.M. and Cronin, E.D. "Technical aspects of the latissimus dorsi myocutaneous flap in breast reconstruction." *Ann. Plast. Surg.* 6(5): 381, 1981.

Blaiklock, C.R., Demetriou, E.L., and Rayner, C.R.W. "The use of a latissimus dorsi myocutaneous flap in the repair of spinal defects in spina bifida." *Br. J. Plast. Surg.* 34: 358, 1981.

Bostwick, J., III. "Reconstruction of the breast." *Acta. Chir. Belg.* 79(2): 125, 1980.

Bostwick, J., III. "Latissimus dorsi flap: current applications." *Ann. Plast. Surg.* 9(5): 377, 1982.

Bostwick, J., III, Nahai, F., Wallace, J.G., and Vasconez, L.O. "Sixty latissimus dorsi flaps." *Plast. Reconstr. Surg.* 63(1): 31, 1979.

Bostwick, J., III, and Scheflan, M. "The latissimus dorsi musculocutaneous flap: a one-stage breast reconstruction." *Clin. Plast. Surg.* 7(1): 71, 1980.

Bostwick, J., III, Scheflan, M., Nahai, F., and Jurkiewicz, M.J. "The 'reverse' latissimus dorsi muscle and musculotaneous flap: anatomical and clinical considerations." *Plast. Reconstr. Surg.* 65(4): 395, 1980.

Bostwick, J., III, Stevenson, T.R., Nahai, F., Hester, T.R., Coleman, J.J., and Jurkiewicz, M.J. "Radiation to the breast: complications amenable to surgical treatment." *Ann. Surg.* 200(4): 543, 1984.

Bostwick, J., III, Vasconez, L.O., and Jurkiewicz, M.J. "Breast reconstruction after a radical mastectomy." *Plast. Reconstr. Surg.* 61(5): 682, 1978.

Broadbent, T.R. and Woolf, R.M. "Breast reconstruction: a better skin pattern." *Aesthetic Plast. Surg.* 7(3): 145, 1983.

Brones, M.F., Wheeler, E.S., and Lesavoy, M.A. "Restoration of elbow flexion and arm contour with the latissimus dorsi myocutaneous flap." *Plast. Reconstr. Surg.* 69(2): 329, 1982.

Buncke, H.H. "Functional reconstruction of an extremity by free tissue transfer of the latissimus dorsi (letter)." *J. Bone Joint Surg.* (Am.) 66(5): 806, 1984.

Campbell, D.A. "Reconstruction of the anterior thoracic wall." *J. Thorac. Surg.* 19: 456, 1950.

Chaikhouni, A., Dyas, C.J., Jr., Robinson, J.H., and Kelleher, J.C. "Latissimus dorsi free myocutaneous flap." *J. Trauma* 21(5): 398, 1981.

Chicarilli, Z.N., Ariyan, S., Glenn, W.W., and Seashore, J.H. "Management of recalcitrant bronchopleural fistulas with muscle flap obliteration." *Plast. Reconstr. Surg.* 75(6): 882, 1985.

Christ, J.E. and Spira, M. "Application of the latissimus dorsi muscle to the heart." *Ann. Plast. Surg.* 8(2): 118, 1982.

Clovutivat, V. "Reconstruction of cheek and buccal mucosa with latissimus dorsi musculocutaneous flap." *Ann. Acad. Med.* Singapore 9(3): 342, 1980.

Cohen, B.E. "Shoulder defect correction with the island latissimus dorsi flap." *Plast. Reconstr. Surg.* 74(5): 650, 1984.

Cohen, B.E. and Cronin, E.D. "Breast reconstruction with the Latissimus dorsi musculocutaneous flap." *Clin. Plast. Surg.* 11(2): 287, 1984.

Cooper, G.G., Webster, M.H.C., and Bell, G. "The results of breast reconstruction following mastectomy." *Br. J. Plast. Surg.* 37: 369, 1984.

Dabb, R.W. and Conklin, W.T. "A sensory innervated latissimus dorsi musculocutaneous free flap: case report." *J. Microsurg.* 2(4): 289, 1981.

Davis, H.H., Tollman, J.P., and Brush, J.H. "Huge chondrosarcoma rib." *Surgery* 26: 699, 1949.

Desprez, J.D., Kiehn, C.L., and Echstein, W. "Closure of large meningomyelocele defects by composite skin muscle flaps." *Plast. Reconstr. Surg.* 47: 234, 1971.

Dinner, M.I. "Value of angiography prior to use of the latissimus dorsi myocutaneous flap (letter)." *Plast. Reconstr. Surg.* 64(4): 553, 1979.

Doi, K., Ihara, K., Sakamoto, T., and Kawai, S. "Functional latissimus dorsi island pedicle musculocutaneous flap to restore finger function." *J. Hand Surg.* 10(5): 678, 1985.

Dowden, R.V., Horton, C.E., Rosato, F.E., and McCraw, J.B. "Reconstruction of the breast after mastectomy for cancer." *Surg. Gynecol. Obstet.* 149: 109, 1979.

Dowden, R.V. and McCraw, J.B. "Muscle flap reconstruction of shoulder defects." *J. Hand Surg.* 5(4): 382, 1980.

Fisher, J., Bostwick, J., III, and Powell, R. "Latissimus dorsi blood supply after thoracodorsal vessel division: the serratus collateral." *Plast. Reconstr. Surg.* 72(4): 502, 1983.

Fisher, J. and Wood, M.B. "The late necrosis of a latissimus dorsi free flap." *Plast. Reconstr. Surg.* 74(2): 274, 1984.

Fodor, P.B. and Khoury, F. "Latissimus dorsi muscle flap in reconstruction of congenitally absent breast and pectoralis muscle." *Ann. Plast. Surg.* 4(5): 422, 1980.

Gordon, L., Buncke, H.J., and Alpert, B.S. "Free latissimus dorsi muscle flap with split-thickness skin graft cover: a report of 16 cases." *Plast. Reconstr. Surg.* 70(2): 173, 1982.

Guly'as, G., Kartik, I., and Tak'acs, L. "Latissimus dorsi musculocutaneous island flap for the reconstruction of soft tissue defects of the upper arm." *Acta. Chir. Plast.* (Prague) 25(2): 72, 1983.

Hagan, K.F., Buncke, H.J., and Gonzalez, R. "Free latissimus dorsi muscle flap coverage of an electrical burn of the lower extremity." *Plast. Reconstr. Surg.* 69(1): 125, 1982.

Handel, N. and Post, G. "Latissimus dorsi musculocutaneous flap in postthoracotomy patient." *Ann. Plast. Surg.* 10(4): 314, 1983.

Haller, J.A., Jr., Colombani, P.M., Miller, D., and Manson, P. "Early reconstruction of Poland's syndrome using autologous rib grafts combined with a latissimus muscle flap." *J. Pediatr. Surg.* 19(4): 423, 1984.

Harashina, T., Takayama, S., Ikuta, Y., and Fujino, T. "Reconstruction of chest-wall radiation ulcer with free latissimus dorsi muscle flap and meshed skin graft." *Plast. Reconstr. Surg.* 71(6): 805, 1983.

Hochberg, J. and Fortes da Silva, F.B. "Latissimus dorsi myocutaneous flap to restore elbow flexion and axillary burn contracture: a report on two pediatric patients." *J. Pediatr. Orthop.* 2(5): 565, 1982.

Jamra, F.N.A., Akel, S.R., and Shamma, A.R. "Repair of major defect of the upper extremity with a latissimus dorsi myocutaneous flap: a case report." *Br. J. Plast. Surg.* 34: 121, 1981.

Jones, B.N., Manske, P.R., Schoenecker, P.L., and Dailey, L. "Latissimus dorsi transfer to restore elbow extension in obstetrical palsy." *J. Pediatr. Orthop.* 5(3): 287, 1985.

Johnson, B., Olofsson, B.M., and Steffner, L.C. "Function of the teres major, latissimus dorsi, and pectoralis major muscles: a preliminary study." *Acta. Morphol. Neerl. Scand.* 9(4): 275, 1972.

Jurkiewicz, M.J. and Arnold, P.G. "The omentum: an account of its use in reconstruction of the chest wall." *Ann. Surg.* 185(5): 548, 1977.

Kanavel, A.B. "Plastic procedures for the obliteration of cavities with non-collapsible walls." *Surg. Gynecol. Obstet.* 32: 453, 1921.

Katsaros, J., Gilbert, D., and Russell, R. "The use of a combined latissimus dorsi-groin flap as a direct flap for reconstruction of the upper extremity." *Br. J. Plast. Surg.* 36: 67, 1983.

Knowlton, E.W. "Release of axillary scar contracture with a latissimus dorsi flap." *Plast. Reconstr. Surg.* 74(1): 124, 1984.

Kobus, K., Stepniewski, J., and Charko, W. "History and remarks on clinical use of groin, dorsalis pedis, and musculocutaneous latissimus dorsi free flaps." *Acta. Chir. Plast.* (Prague) 24(2): 74, 1982.

Krishna, B.V. and Green, M.F. "Extended role of latissimus dorsi myocutaneous flap in reconstruction of the neck." *Br. J. Plast. Surg.* 33: 233, 1980.

Lai, M.F., Milroy, B.C., and Pennington, D.G. "Shoulder defect cover with functional restoration using the latissimus dorsi myocutaneous flap: a case report." *Br. J. Plast. Surg.* 35: 140, 1982.

Laitung, J.K. and Peck, F. "Shoulder function following the loss of the latissimus dorsi muscle." *Br. J. Plast. Surg.* 38(3): 375, 1985.

Landra, A.P. "The latissimus dorsi musculocutaneous flap used to resurface a defect on the upper arm and restore extension to the elbow." *Br. J. Plast. Surg.* 32(4): 275, 1979.

LaRossa, D., Mellissinos, E., Matthews, D., and Hamilton, R. "The use of microvascular free skin-muscle flaps in management of avulsion injuries of the lower leg." *J. Trauma* 20(7): 545, 1980.

Larson, D.L. and McMurtrey, M.J. "Musculocutaneous flap reconstruction of chest-wall defects: an experience with 50 patients." *Plast. Reconstr. Surg.* 73(5): 734, 1984.

Larson, D.L., McMurtrey, M.J., Howe, J.H., and Irish, C.E. "Major chest wall reconstruction after chest wall irradiation." *Cancer* 49(6): 1286, 1982.

Larsson, S., Pettersson, G., Eldh, J., and Eriksson, E. "Reconstruction of large anterior full-thickness defect in the chest wall after resection of chondrosarcoma." *Scand. J. Thorac. Cardiovasc. Surg.* 18(1): 63, 1984.

Lassen, M., Krag, C., and Nielsen, I.M. "The latissimus dorsi flap: an overview." *Scand. J. Plast. Reconstr. Surg.* 19(1): 41, 1985.

Lehrman, A. and Owen, M.P. "Surgical repair of large meningomyeloceles." *Ann. Plast. Surg.* 12(6): 501, 1984.

Lejour, M., Alemanno, P., and DeMay, A. "Analysis of 56 breast reconstructions using the latissimus dorsi flap." *Ann. Chir. Plast. Esth.* 30: 7, 1985.

Levine, R.A. and DeFelice, C.A. "Possible explanation of successful latissimus dorsi flap without the thoracodorsal artery." *Plast. Reconstr. Surg.* 65(4): 532, 1980.

Lewinsky, B.S. "Latissimus dorsi myocutaneous flap (letter)." *Arch. Otolaryngol.* 110(5): 341, 1984.

Logan, A.M. and Black, M.J. "Injury to the brachial plexus resulting from shoulder positioning during latissimus dorsi flap pedicle dissection." *Br. J. Plast. Surg.* 38(3): 380, 1985.

Luce, E.A. and Walsh, J. "Wound closure of the myelomeningocoele defect." *Plast. Reconstr. Surg.* 75(3): 389, 1985.

MacKinnon, S.E., Weiland, A.J., and Godina, M. "Immediate forearm reconstruction with a functional latissimus dorsi island pedicle myocutaneous flap." *Plast. Reconstr. Surg.* 71(5): 706, 1983.

Magee, W.P., Jr., Gilbert, D.A. and McInnis, W.D. "Extended muscle and musculocutaneous flaps." *Clin. Plast. Surg.* 7(1): 57, 1980.

Marshall, D.R., Anstee, E.J., and Stapleton, M.J. "Immediate reconstruction of the breast following modified radical mastectomy for carcinoma." *Br. J. Plast. Surg.* 35: 438, 1982.

Marshall, D.R., Anstee, E.J., and Stapleton, M.J. "Soft tissue reconstruction of the breast using an extended composite latissimus dorsi myocutaneous flap." *Br. J. Plast. Surg.* 37(3): 361, 1984.

Maruyama, Y., Urita, Y., and Ohnishi, K. "Rib-latissimus dorsi osteomyocutaneous flap in reconstruction of a mandibular defect." *Br. J. Plast. Surg.* 38(2): 234, 1985.

Maves, M.D., Panje, W.R., and Shagets, F.W. "Extended latissimus dorsi myocutaneous flap reconstruction of major head and neck defects." *Otolaryngol. Head Neck Surg.* 92(5): 551, 1984.

Maxwell, G.P. "Iginio Tansini and the origin of the latissimus dorsi musculocutaneous flap." *Plast. Reconstr. Surg.* 65(5): 686, 1980.

Maxwell, G.P. "Latissimus dorsi breast reconstruction: an aesthetic assessment." *Clin. Plast. Surg.* 8(2): 373, 1981.

Maxwell, G.P., Horton, C.E., and McCraw, J.B. "Cancer trends: breast reconstruction after mastectomy." *Va. Med.* 108: 328, 1981.

Maxwell, G.P., Leonard, L.G., Manson, P.N., and Hoopes, J.E. "Craniofacial coverage using the latissimus dorsi myocutaneous island flap." *Ann. Plast. Surg.* 4(5): 410, 1980.

Maxwell, G.P., Manson, P.N., and Hoopes, J.E. "Experience with thirteen latissimus dorsi myocutaneous free flaps." *Plast. Reconstr. Surg.* 64(1): 1, 1979.

Maxwell, G.P., McGibbon, B.M., and Hoopes, J.E. "Vascular considerations in the use of a latissimus dorsi myocutaneous flap after a mastectomy with an axillary dissection." *Plast. Reconstr. Surg.* 64(6): 771, 1979.

Maxwell, G.P., Stueber, K., and Hoopes, J.E. "A free latissimus dorsi myocutaneous flap: case report." *Plast. Reconstr. Surg.* 62(3): 462, 1978.

May, J.W., Jr., Gallico, G.G., III, Jupiter, J., and Savage, R.C. "Free latissimus dorsi muscle flap with skin graft for treatment of traumatic chronic bony wounds." *Plast. Reconstr. Surg.* 73(4): 641, 1984.

McCraw, J.B., Bostwick, J. III, and Horton, C.E. "Methods of soft tissue coverage for the mastectomy defect." *Clin. Plast. Surg.* 6(1): 57, 1979.

McCraw, J.B., Dibbell, D.G., and Carraway, J.H. "Clinical definition of independent myocutaneous vascular territories." *Plast. Reconstr. Surg.*, 60: 341, 1977.

McCraw, J.B. and Horton, C.E. "Reconstruction of the breast." *Va. Med.* 109: 770, 1982.

McCraw, J.B., Maxwell, G.P., and Horton, C.E. "Reconstruction of the breast following mastectomy." *Acta Chir. Belg.* 2: 131, 1980.

McCraw, J.B., Penix, J.O., and Baker, J.W. "Repair of major defects of the chest wall and spine with the latissimus dorsi myocutaneous flap." *Plast. Reconstr. Surg.* 62(2): 197, 1978.

McGregor, J.C. "The 'reverse' latissimus dorsi musculocutaneous flap: case report." *J.R. Coll. Surg. Edinb.* 28(3): 154, 1983.

Medgyesi, S. "A successful operation for lymphaedema using a myocutaneous flap as a 'wick'." *Br. J. Plast. Surg.* 36: 64, 1983.

Mendelson, B.C. "The latissimus dorsi flap for breast reconstruction." *Aust. N.Z. J. Surg.* 50(2): 200, 1980.

Mendelson, B.C. "Latissimus dorsi breast reconstruction: refinement and results." *Br. J. Plast. Surg.* 70(3): 145, 1983.

Mendelson, B.C. and Masson, J.K. "Treatment of chronic radiation injury over the shoulder with a latissimus dorsi myocutaneous flap." *Plast. Reconstr. Surg.* 60(5): 681, 1977.

Millard, D.R., Jr. "Breast aesthetics when reconstructing with the latissimus dorsi musculocutaneous flap." *Plast. Reconstr. Surg.* 70(2): 161, 1982.

Moore, T.S., Dreyer, T.M., and Bevin, A.G. "Closure of large spina bifida cystica defects with bilateral bipedicled musculocutaneous flaps." *Plast. Reconstr. Surg.* 73(2): 288, 1984.

Morain, W.D. "Flaps of the latissimus dorsi muscle in difficult wounds of the trunk and arm." *Am. J. Surg.* 145(4): 520, 1983.

Morris, R.L., Given, K.S., and McCabe, J.S. "Repair of head and neck defects with the latissimus dorsi myocutaneous flap." *Am. Surg.* 47(4): 167, 1981.

Muhlbauer, W. and Olbrisch, R. "The latissimus dorsi myocutaneous flap for breast reconstruction." *Chir. Plastica*. 4: 27, 1977.

Muldowney, J.B., Magi, E., Hein, K., and Birdsell, D. "The reverse latissimus dorsi myocutaneous flap with functional preservation: report of a case." *Ann. Plast. Surg*. 7(2): 150, 1981.

Nakajima, H. and Fujino, T. "Island fasciocutaneous flaps of dorsal trunk and their application to myocutaneous flaps." *Keio. J. Med*. 33(2): 59, 1984.

Narula, A.A. and Breach, N.C. "The use of the latissimus dorsi muscle flap for posterior scalp defects." *J. Laryngol. Otol*. 99(7): 693, 1985.

Nash, A.G. and Hurst, P.A. "Central breast carcinoma treated by simultaneous mastectomy and latissimus dorsi flap reconstruction." *Br. J. Surg*. 70(11): 654, 1983.

Nielsen, I.M., Lassen, M., Gregersen, B.N., and Krag, C. "Experience with the latissimus dorsi flap." *Scand. J. Rehabil. Med*. 17(2): 53, 1985.

O'Brien, B.M., Morrison, W.A., Lawler, D.L., MacLeod, A., and Newing, R.K. "The versatile latissimus dorsi myocutaneous flap in breast and other reconstruction." *Aust. N.Z. J. Surg*. 52(2): 174, 1982.

Ogawa, J., Inoue, H., Shohtsu, A., Tajima, T., Tanino, R., and Yamazaki, S. "Reconstruction of sternal defects with autologus bone grafts and myocutaneous flap of the latissimus dorsi muscle." *Tokai J. Exp. Clin. Med*. 7(1): 63, 1982.

Ohmori, K. and Takada, H. "Correction of Poland's pectoralis major muscle anomaly with latissimus dorsi musculocutaneous flaps." *Plast. Reconstr. Surg*. 65(4): 400, 1980.

Olivari, N. "The latissimus flap." *Br. J. Plast. Surg*. 29: 126, 1976.

Olivari, N. "Use of thirty latissimus dorsi flaps." *Plast. Reconstr. Surg*. 64(5): 654, 1979.

Pendergast, W.J., Jr., Bostwick, J., III, and Jurkiewicz, M.J. "The subcutaneous mastectomy cripple: surgical rehabilitation with the latissimus dorsi flap." *Plast. Reconstr. Surg*. 66(4): 554, 1980.

Pousset, C., Salmon, R.J., Soussaline, M., et al. "The use of a latissimus dorsi myocutaneous flap for the treatment of recurrent breast cancer." *Ann. Chir. Plast. Esth*. 31: 82, 1986.

Quillen, C.G. "Latissimus dorsi myocutaneous flaps in head and neck reconstruction." *Plast. Reconstr. Surg*. 63(5): 664, 1979.

Quillen, C.G., Shearin, J.C., Jr., and Georgiade, N.G. "Use of the latissimus dorsi myocutaneous island flap for reconstruction in the head and neck area: case report." *Plast. Reconstr. Surg*. 62(1): 113, 1978.

Ramming, K.P., Holmes, E.C., Zarem, H.A., Lesavoy, M.A., and Morton, D.L. "Surgical management and reconstruction of extensive chest wall malignancies." *Am. J. Surg*. 144(1): 146, 1982.

Reid, C.D. and Taylor, G.I. "The vascular territory of the acromiothoracic axis." *Br. J. Plast. Surg*. 37: 194, 1984.

Rosen, H.M. "Double island latissimus dorsi muscle-skin flap for through-and-through defects of the forefoot." *Plast. Reconstr. Surg*. 76(3): 461, 1985.

Rowsell, A.R., Davies, D.M., Eisenberg, N., and Taylor, G.I. "The anatomy of the subscapular-thoracodorsal arterial system: study of 100 cadaver dissections." *Br. J. Plast. Surg*. 37(4): 574, 1984.

Rubinstein, Z.J., Shafir, R., and Tsur, H. "The value of angiography prior to the use of the latissimus dorsi myocutaneous flap." *Plast. Reconstr. Surg*. 63(3): 374, 1979.

Sabatier, R.E. and Bakamjian, V.Y. "Transaxillary latissimus dorsi flap reconstruction in head and neck cancer: limitations and refinements in 56 cases." *Am. J. Surg*. 150(4): 427, 1985.

Scheflan, M., Mehrhof, A.I., Jr., and Ward, J.D. "Meningomyelocele closure with distally based latissimus dorsi flap." *Plast. Reconstr. Surg*. 73(6): 956, 1984.

Schmidt, D.R. and Robson, M.C. "One-stage composite reconstruction using the latissimus myoosteocutaneous free flap." *Am. J. Surg*. 144(4): 470, 1982.

Schneider, W.J., Hill, H.L., Jr., and Brown, R.G. "Latissimus dorsi myocutaneous flap for breast reconstruction." *Br. J. Plast. Surg*. 30(4): 277, 1977.

Schuller, D.E. "Latissimus dorsi myocutaneous flap for massive facial defects." *Arch. Otolaryngol*. 108(7): 414, 1982.

Shesol, B.F. and Clarke, J.S. "Intrathoracic application of the latissimus dorsi musculocutaneous flap." *Plast. Reconstr. Surg*. 66(6): 842, 1980.

Silverton, S., Nahai, F., and Jurkiewicz, M.J. "The latissimus dorsi myocutaneous flap to replace a defect on the upper arm." *Br. J. Plast. Surg*. 31(1): 29, 1978.

Smith, A.R., Sonneveld, G.J., and van Alphen, V.A. "The free latissimus dorsi flap in reconstructive microsurgery." *Neth. J. Surg*. 37(1): 7, 1985.

Stern, P.J., Neale, H.W., Gregory, R.O., and Kreilein, J.G. "Latissimus dorsi musculocutaneous flap for elbow flexion." *J. Hand Surg*. (Am.) 7(1): 25, 1982.

Stern, P.J., Neale, H.W., Gregory, R.O., and McDonough, J.J. "Functional reconstruction of an extremity by free tissue transfer of the latissimus dorsi." *J. Bone Joint Surg*. (Am.) 65(6): 729, 1983.

Stevenson, T.R., Duus, E.C., Greene, T.L., and Dingman, R.O. "Traumatic upper arm defect treated with latissimus dorsi muscle transposition." *J. Pediatr. Ortho*. 4(1): 111, 1984.

Stevenson, T.R., Rohrich, R.J., Pollock, R.A., Dingman, R.O., and Bostwick, J., III. "More experience with the 'reverse' latissimus dorsi musculocutaneous flap: precise location of blood supply." *Plast. Reconstr. Surg*. 74(2): 237, 1984.

Takami, H., Takahashi, S., and Ando, M. "Latissimus dorsi transplantation to restore elbow flexion to the paralysed limb." *J. Hand Surg.* 9(1): 61, 1984.

Takami, H., Takahashi, S., and Ando, M. "Microvascular free musculocutaneous flaps for the treatment of avulsion injuries of the lower leg." *J. Trauma* 23(6): 473, 1983.

Takayanagi, S. and Tsukie, T. "Our experiences with the free latissimus dorsi myocutaneous flap." *Ann. Plast. Surg.* 5(6): 442, 1980.

Thomas, J.M. "Latissimus dorsi reconstruction of the breast (editorial)." *Br. Med. J.* (Clin. Res.) 287(6392): 569, 1983.

Tizian, C., Borst, H.G., and Berger, A. "Treatment of total sternal necrosis using the latissimus dorsi muscle flap." *Plast. Reconstr. Surg.* 76(5): 703, 1985.

Tobin, G.R., Mavroudis, C., Howe, W.R., and Gray, L.A., Jr. "Reconstruction of complex thoracic defects with myocutaneous and muscle flaps: applications of new flap refinements." *J. Thorac. Cardiovasc. Surg.* 85(2): 219, 1983.

Tobin, G.R., Moberg, A.W., DuBou, R.H., Weiner, L.J., and Bland, K.I. "The split latissimus dorsi myocutaneous flap." *Ann. Plast. Surg.* 7(4): 272, 1981.

Tobin, G.R., Schusterman, M., Peterson, G.H., Nichols, G., and Bland, K.I. "The intramuscular neurovascular anatomy of the latissimus dorsi muscle: the basis for splitting the flap." *Plast. Reconstr. Surg.* 67(5): 637, 1981.

Tomono, T., Hirose, T., Matsuo, K., and Matsui, T. "A denuded 'turn-over' deltopectoral flap combined with a latissimus dorsi myocutaneous flap in the repair of extensive radionecrosis of the chest wall." *Br. J. Plast. Surg.* 35: 63, 1982.

Vasconez, L.O., Johnson-Giebink, R., and Hall, E.J. "Breast reconstruction." *Clin. Plast. Surg.* 7(1): 79, 1980.

Vila, R. and Guinot, A. "Post-mastectomy breast reconstruction in an irradiated field using a contralateral latissimus dorsi free flap." *Br. J. Plast. Surg.* 35: 371, 1982.

Watson, J.S. "The use of the latissimus dorsi island flap for intra-oral reconstruction." *Br. J. Plast. Surg.* 35: 408, 1982.

Watson, J.S., Craig, R.D.P., and Orton, C.I. "The free latissimus dorsi myocutaneous flap." *Plast. Reconstr. Surg.* 64(3): 299, 1979.

Watson, J.S., and Lendrum, J. "One-stage pharyngeal reconstruction using a compound latissimus dorsi island flap." *Br. J. Plast. Surg.* 34: 87, 1981.

Wolf, L.E. and Biggs, T.M. "Aesthetic refinements in the use of the latissimus dorsi flap in breast reconstruction." *Plast. Reconstr. Surg.* 69(5): 788, 1982.

Yamamoto, K., Yokota, K., and Higaki, K. "Entire pharyngoesophageal reconstruction with latissimus dorsi myocutaneous island flap." *Head Neck Surg.* 7(6): 461, 1985.

Zancolli, E. and Mitre, H. "Latissimus dorsi transfer to restore elbow flexion: an appraisal of eight cases." *J. Bone Joint Surg.* (Am.) 55(6): 1265, 1973.